Declaration for Translation of Priority Document

I, the undersigned Toshiaki Kinoshita
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do solemnly and sincerely declare that I am well acquainted with the Japanese language and the English language and that the attached English translation of a certified copy of JPA2000-42531 filed on February 21, 2000 is a true, correct and faithful translation to the best of my knowledge and belief from the Japanese language into the English language.

Dated this 11th day of June, 2007

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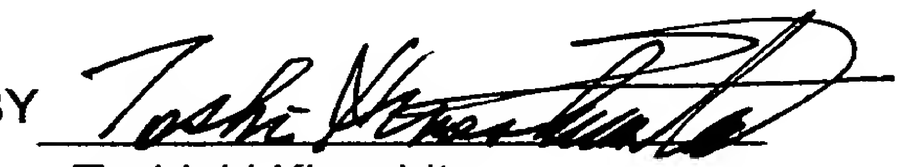
BY 
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[Title of the Invention] DIGITAL BROADCAST RECEIVING APPARATUS

[Claims]

[Claim 1] A digital broadcast receiving apparatus characterized in having a configuration to multiplex transport stream packet corresponding to necessary packet identifier in a transport stream with transport stream packet corresponding to necessary packet identifier in another transport stream.

[Claim 2] A digital broadcast receiving apparatus characterized in having such a configuration that transport stream packet corresponding to necessary packet identifier in another transport stream overwrites to unnecessary packet area corresponding to unnecessary packet identifier in a transport stream.

[Claim 3] A digital broadcast receiving apparatus characterized in having such a configuration that transport stream packet corresponding to necessary packet identifier in a transport stream are extracted, and transport stream packets corresponding to necessary packet identifier in another transport stream are also extracted, and then said transport stream packets extracted from both of the transport streams are mutually inserted.

[Claim 4] A digital broadcast receiving apparatus as defined in any one of claims 1 to 3, characterized in having such a configuration that, when each of transport stream packets to be multiplexed by either the overwriting or the insertion have identical packet identifier, at least one of the packet identifiers is rewritten so that they have different packet identifiers from each other.

[Claim 5] A digital broadcast receiving apparatus as defined in claim 4, characterized in having such a

configuration that packet identifier of the transport stream packet side that is newly added through the overwriting is rewritten.

[Claim 6] A digital broadcast receiving apparatus as defined in any of claims 2 to 5, characterized in having such a configuration that null packet area is prioritized as said unnecessary packet area corresponding to the unnecessary packet identifier.

[Claim 7] A digital broadcast receiving apparatus characterized in comprising:

unnecessary packet detecting means for detecting unnecessary packet area corresponding to unnecessary packet identifier in a transport stream that is inputted;

necessary packet extracting means for extracting transport stream packet corresponding to necessary packet identifier in another transport stream that is inputted; and

packet overwriting means for overwriting transport stream packet extracted by said necessary packet extracting means to said unnecessary packet area detected by said unnecessary packet detecting means in the transport stream.

[Claim 8] A digital broadcast receiving apparatus characterized in comprising:

necessary packet extracting means for extracting transport stream packet corresponding to necessary packet identifier in a transport stream that is inputted;

another necessary packet extracting means for extracting transport stream packet corresponding to necessary packet identifier in another transport stream that is inputted; and

packet inserting means for inserting each of said extracted packets in both of the transport streams to mutually to generate a new transport stream.

[Claim 9] A digital broadcast receiving apparatus as defined in claim 7 or 8, characterized in comprising:

identical packet identifier determining means for determining whether or not identical packet identifiers are held with respect to both of the transport stream packets to be multiplexed with each other through said overwriting or insertion; and

packet identifier converting means for rewriting at least one of packet identifiers so that opponent-side packet identifier is made different with respect to the transport stream packets that are determined by said identical packet identifier determining means.

[Claim 10] A digital broadcast receiving apparatus as defined in claim 7 or 9, characterized in comprising:

null packet counting means for counting null packets from said transport stream on the side to be overwritten;

packet counting means for counting post-extraction transport stream packets on the side to be added through said overwriting;

comparing means for comparing a null packet count value outputted by said null packet counting means with a transport stream packet count value outputted by said packet counting means; and

NULL-packet-priority designating means for designating null packet area with priority as unnecessary packet area corresponding to said unnecessary packet identifier when said former count value is equal to or greater than the latter count value.

[Claim 11] A digital broadcast receiving apparatus as defined in claim 7 or 9, characterized in having such a constitution that said packet overwriting means offer preference to said NULL-packet areas as overwriting objects when a detection frequency of NULL packets in said

transport stream on the overwritten-side is high; and concurrently, the overwriting thereof is executed to other unnecessary-packet areas when overwriting of said extracted transport stream packets to NULL packets is interrupted and the number of packets waiting for the overwriting reaches a predetermined value.

[Claim 12] A digital broadcast receiving apparatus as defined in any one of claims 1 to 11, characterized in having such a constitution that a plurality of transport streams arbitrarily selectable from the ones listed below are made as object as a plurality of transport streams including transport stream packets multiplexed through either the overwriting or the insertion:

(a) a transport stream including audiovisual request broadcast program data;

(b) a transport stream including data concerning broadcast program table;

(c) a transport stream including downloadable data;

(d) a transport stream including image-recording-request broadcast program data;

(e) a transport stream including data of broadcast program data; and

(f) transport streams including other broadcast program data;

and packets in the plurality of selected transport streams are multiplexed.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

The present invention relates to a digital broadcast receiving apparatus for receiving digital broadcasting wherein various programs (contents) such as video programs, various service information, data broadcast programs,

downloadable data and music programs are digitized and multiplexed. The digital broadcasting aimed at by the present invention may include any of CS digital broadcasting, BS digital broadcasting, digital terrestrial broadcasting, CATV digital broadcasting and other forms of digital broadcasting.

[0002]

[Prior Art]

In digital broadcasting, there is a plurality of broadcast channels (transmission path, channel, transponder or frequency band) for broadcasting, and a plurality of programs (programs, contents) can be broadcast in multiplexed form in one channel. The apparatus for receiving such digital broadcasting is the digital broadcast receiving apparatus.

[0003]

Fig. 25 shows an electrical configuration of the digital broadcast receiving apparatus according to a prior art.

[0004]

This digital broadcast receiving apparatus includes a tuner 601 for receiving through selectively syntonizing a modulated wave included in a channel designated by a user from a plurality of modulated waves sent out to a transmission path, a demodulator section 602 for performing digital demodulation to the received modulated wave and executing error correction so as to output a transport stream (TS) based on MPEG (Moving Picture Coding Experts Group) 2, a transport stream separating section (TD) 604 for separating and retrieving an targeted transport stream packet from a transport stream (TS) where a plurality of program information is multiplexed, an image decoder 605 for generating image information by extending and decoding

a separated image stream, a screen synthesizer 606 for generating an image signal by synthesizing image information and service information, an audio decoder 607 for generating an audio signal by extending and decoding a separated audio stream so as to obtain an analog data, a digital interface 608 for outputting separated transport information, a CPU 609 performing control of the apparatus as a whole, a ROM (read-only memory) 610 for storing a control program, a RAM (random access memory) 611 as a working memory, an input section 612 such as a front panel button or a remote control transmitter, and a bus 613 for connecting the CPU 609 to each part as shown in the figure. In Fig. 25, a monitor 801 connected to the image synthesizer 606, a speaker 802 connected to the audio decoder 607 and a digital recording device 803 connected to the digital interface 608 are also shown.

[0005]

The modulated wave received in the tuner 601 is demodulated with the demodulator section 602 to execute error correction, and a transport stream (TS) is generated. The transport stream separating section 604 retrieves a stream consisting of only the packets associated with a targeted content set by the user. Here, the image stream retrieved is converted into image information by the image decoder 605 and transferred to the image synthesizer 606. Also, with respect to the service information included in the data stream retrieved, only the information designated by the user is stored provisionally in the RAM 611 through the CPU bus 613 from the transport stream separating section 604 and transferred by the CPU 609 from the RAM 611 to the screen synthesizer 606. In the image synthesizer 606, the image information and the service information are synthesized and the image thereof is displayed on the

monitor 801. Also, the audio stream retrieved is converted into an audio signal by the audio decoder 607, and outputted as a sound from the speaker 802. Also, the transport information retrieved by the transport stream separating section 604 is recorded in the digital recording device 803 through the digital interface 608.

[0006]

Now, the unit of data transmission in the transport stream, that is transmitted from the digital broadcast transmitting apparatus and received by the digital broadcast receiving apparatus, is called a "packet". Regardless of from what the information to be transmitted is generated, all the information is transmitted by packet. Furthermore, the basic size of the packet is 188 bytes. Fig. 26 shows a configuration of a transport stream packet.

[0007]

The transport stream packet is configured with a 4-byte packet header and a 184-byte data field consisting of an adaptation field and a payload (user information). The header includes an identifier (PID: Packet Identifier) for discriminating each of transport stream packets. This is the packet identifier (PID). A desired packet is extracted based on the packet identifier (PID) from the received transport stream (TS), and a program is reproduced.

[0008]

In the transmission of transport stream form, program specific information (PSI: Program Specific Information) is transmitted to comply with a multiprogram in which a plurality of programs (programs, contents) are multiplexed and transmitted in one transport stream.

[0009]

The program specific information (PSI) includes a network information table (NIT) for describing information

that correlates information of a transmission path with a broadcast service, a program association table (PAT) for describing a program configuration, a program map table (PMT) for describing a packet identifier (PID) of a transport stream making up each program and an entitlement control message (ECM) for describing the information inherent in a program required for descrambling a program.

[0010]

In the digital broadcast receiving apparatus, it becomes possible to select a specific transport stream so as to be descramble it and reproduce a desired program through analyzing these pieces of program specific information (PSI) and acquiring a necessary packet identifier (PID).

[0011]

In order to present program information to the user, broadcast program layout information (SI: Service Information) is also transmitted.

[0012]

The broadcast program layout information (SI) includes an event information table (EIT) for describing a name, date/hour and a content of the program and a service description table (SDT) for describing information on an organization channel. By analyzing these pieces of broadcast program layout information (SI), a broadcast program table and a broadcast content can be presented to the user.

[0013]

The program specific information (PSI) and the broadcast program layout information (SI) are stored in the data field shown in Fig. 26.

[0014]

In the conventional digital broadcast receiving

apparatus shown in Fig. 25, the transport stream separating section 604 can process a transport stream (TS) of only one system. Therefore, it generates a case where a plurality of contents cannot be acquired at the same time.

[0015]

In the case where the transport stream (TS) including an audiovisual request program and the transport stream (TS) including an image-recording request program exist in different transmission paths, for example, the screen-viewing and the image-recording cannot be carried out simultaneously.

[0016]

Also, in the case where the broadcast program layout information (SI) making up a broadcast program table is transmitted only in a specific transport stream (TS) as in the CS digital broadcasting, the broadcast program table cannot be displayed while screen-viewing when the broadcast program under viewing is included in a transport stream different from the broadcast program layout information (SI).

[0017]

Also, in the case where downloadable data is transmitted only in a specific transport stream as in the CS digital broadcasting, a new program cannot be downloaded while screen-viewing when the broadcast program under viewing is included in a transport stream different from the downloadable data.

[0018]

Also, in the case where a transport stream including a viewing-request program and a transport stream including data broadcasting such as an electronic music delivery (EMD) are different from each other, the screen-viewing and the receiving of the data broadcasting cannot be carried

out simultaneously.

[0019]

Assuming that the digital broadcast receiving apparatus shown in Fig. 25 includes a plurality of tuners and demodulator sections and has a configuration in which the plurality of the demodulator sections are switched over to one transport stream separating section, a plurality of transport streams can be selectively received. As long as the transport stream separating section is single, however, only one transport stream can be processed in one time.

[0020]

Supposing that the transport stream separating sections corresponding to the number of transport streams desired to be processed or a transport stream separating section capable of processing a plurality of transport streams is incorporated, arbitrary contents included in a plurality of different transport streams (TS) can be arbitrarily combined and acquired at the same time. However, it becomes very expensive and causes a large size of the apparatus to take such a configuration.

[0021]

There is the digital broadcast receiving apparatus disclosed in Japanese Unexamined Patent Application Publication No. 11-122556, as a technique capable of handling a plurality of transport streams (TS) and extracting arbitrary contents from an arbitrary transport stream.

[0022]

The digital broadcast receiving apparatus disclosed in Japanese Unexamined Patent Application Publication No. 11-122556 includes a plurality of tuners, a plurality of demodulator sections (with the error correcting function) connected to each of the tuners, and a multiplexer section

inserted between the plurality of the demodulator sections and a single transport stream separating section.

[0023]

The feature of the digital broadcast receiving apparatus disclosed in the aforementioned publication lies in that the multiplexer section generates one new transport stream by time division multiplexing transport streams (TS) of three systems based on a unit of the packet, and at the time it has a function that the time division multiplexing is carried out at a frequency higher than the sum of the transmission bit rates of the three broadcast systems. The "3" systems described above is only an example, and generally, a plurality of systems can be used.

[0024]

[Problem to be solved by the Invention]

There are the following problems in the digital broadcast receiving apparatus disclosed in Japanese Unexamined Patent Application Publication No. 11-122556.

[0025]

(1) If the time division multiplexing is to be carried out at a frequency higher than the sum of the transmission bit rates of the respective broadcast signals in a new multiplexer section, a high-performance oscillator (crystal, etc.) for generating such a high frequency is essential. Such an oscillator, however, is very expensive.

[0026]

Further, since the time division multiplexing at a frequency higher than the one generated by the oscillator is impossible, a highly functional oscillator is required to be attached in advance.

[0027]

(2) With regard to the transport stream separating section at the subsequent stage of the multiplexer section,

the conventional transport stream separating means cannot process such a transport stream in the case where the bit rate of the new one transport stream generated by multiplexing exceeds a predetermined value and the speed thereof is excessively high. Therefore, in the case where a plurality of transport streams is multiplexed under the situation of (1), there is a possibility that the targeted transport packet cannot be separated.

[0028]

(3) In the case where the same packet identifier (PID) is used for each of broadcast signals, the problem may arise that the decoding is impossible.

[0029]

As illustrated in the same publication, these problems may be solved through adding a broadcast method identifier to all the transport stream packets. Such a measure, however, is very complicated. Further, the transport stream, to which such a broadcast method identifier is added, cannot be processed by the currently available transport stream separating means, and new transport stream separating means capable of processing including such a broadcast method identifier is required. It is, however, very expensive.

[0030]

The present invention aims to solve the problem of impossibility of simultaneous processing of a plurality of transport streams in the conventional digital broadcast receiving apparatus shown in Fig. 25 in a broad sense in the course of the process of technical development. Specifically, the object of the present invention is to provide a digital broadcast receiving apparatus capable of receiving a variety of broadcast services at the same time without providing a plurality of transport stream

separating sections. However, the object of the present invention is not limited thereto, and more directly, to solve the aforementioned problem in the digital broadcast receiving apparatus disclosed in Japanese Unexamined Patent Application Publication No. 11-122556.

[0031]

[Means for Solving the Problem]

The digital broadcast receiving apparatus according to the present invention that aims to solve the aforementioned problem is based on, as a central concept thereof, an identifier (defined as "necessary packet identifier" herein) for designating packets required by a user that are included in a certain transport stream. Specifically, the transport stream packet required by the user, i.e. the necessary packet included in a certain transport stream is grasped according to the corresponding necessary packet identifier. Also, a similar necessary packet included in another transport stream is grasped according to the corresponding necessary packet identifier. In this case, the number of the targeted transport streams is not necessarily two, but may be three or more. Also, the types (categories) of the necessary packets in the plurality of the transport streams may be- either different or partly or entirely identical with each other. The necessary packets in the plurality of these transport streams are multiplexed by such a technique as overwriting or insertion so as to generate a new common transport stream (which is herein defined as "custom transport stream (CTS)").

[0032]

In the common custom transport stream thus newly generated, a plurality of necessary packets is included in a plurality of necessary transport streams originally

different from each other in a merged state. Therefore, the digital broadcast reception mode can be given significant diversity. Thereby, regardless of which transport stream includes information such as a broadcast program accompanying image/audio, a broadcast program table, downloadable data and a data broadcast such as an electronic music delivery which are outputted from the digital broadcasting communication apparatus, various services such as audio-viewing, broadcast program table display, video-ecording, downloading, data-broadcast reception, multiscreen display can be arbitrarily combined to achieve at the same time.

[0033]

Namely, digital-broadcast reception rich in variety can be implemented, for example, so that a broadcast program table included in a transport stream which is different from the transport stream including the aforementioned broadcast program, is simultaneously displayed while a broadcast program is viewed; a broadcast program included in another transport stream is simultaneously image-recorded while a broadcast program is viewed; data such as a program included in another transport stream is simultaneously downloaded while a broadcast program is viewed; a data broadcast program included in another transport stream is simultaneously received while a broadcast program is viewed; data such as a program included in another transport stream is simultaneously downloaded while a program is recorded; a data broadcast program included in another transport stream is simultaneously received while a program is recorded; and data such as a program included in another transport stream is simultaneously downloaded while a data broadcast program is received.

[0034]

To achieve the above, it is sufficient to separate necessary packets from a common custom transport stream containing a plurality of necessary packets in a merged state that has been included in a plurality of transport streams originally different from each other. Therefore, it is enough to use a common transport stream separating section, and this allows to be constituted with various rear-stage members such as a decoder and a digital interface corresponding to single-system transport stream. Thereby, reduction in the cost and size can be achieved.

[0035]

According to the present invention, the advantages are not limited to those described above, but as compared with the conventional digital broadcast receiving apparatus (see Japanese Unexamined Patent Application Publication No. 11-122556, for example) constructed so that all the transport stream packets in each of a plurality of transport streams are multiplexed by time division at a frequency higher than the sum of transmission bit rates of the transport streams to generate a single system transport stream, the means for generating a high frequency as described above is not required, thereby further reducing the cost, while exerting an excellent effect that a high-speed transport stream can be targeted as the transport stream capable of handling.

[0036]

In addition, when packets to be multiplexed (overwritten or inserted) have identical packet identifiers, it is constituted so that the packet identifiers are rewritten so as to convert it to different packet identifiers one another. Thereby, the plurality of packets of different origin in the common custom transport stream

are made to be in an identifiable state one another in the common custom transport stream, which allows the respective packet identifiers of all the packets to be determined uniquely. Therefore, desired packets can be acquired securely and accurately.

[0037]

[Best Embodiment of the Invention]

Embodiments of the present invention will be described below collectively.

[0038]

A digital broadcast receiving apparatus according to a first embodiment of the present invention is characterized in being configured so as to multiplex transport stream packet corresponding to necessary packet identifier in a transport stream with transport stream packet corresponding to necessary packet identifier in another transport stream. This configuration according to the first embodiment of the invention is substantially identical with the configuration described above in the section "Means for Solving the Problem".

[0039]

According to the first embodiment of the invention, generated is a common custom transport stream including a plurality of the necessary packets contained in a plurality of transport streams originally different from each other as described above at a merged state. Therefore, not only transport stream separating means but also various rear-stage members such as a decoder and an interface, can be simply constructed corresponding to single-system transport stream. Further, the first embodiment of the invention avoids does not need such high-frequency generating means as used in the case of the conventional digital broadcast receiving apparatus (e.g., Japanese Unexamined Patent

Application Publication No. 11-122556) in which the time division multiplexing is performed at a frequency higher than the sum of transmission bit rates of individual transport streams. Also, since it is possible to handle transport streams having higher bit rates, the cost and size can be reduced overall.

[0040]

A digital broadcast receiving apparatus according to a second embodiment of the present invention is characterized in being configured so as to overwrite transport stream packet corresponding to necessary packet identifier in another transport stream to unnecessary-packet area corresponding to unnecessary packet identifier in a transport stream.

[0041]

In this second embodiment of the invention, the former transport stream is used in the stream state without dividing and, on the other hand, the latter transport stream is divided into the unit of the packet.

[0042]

That is, in the former transport stream, the unnecessary-packet area is grasped in the stream state without change based on the unnecessary packet identifier; and the necessary packet is extracted at a unit of the packet from the latter another transport stream based on the necessary packet identifier. By overwriting the extracted necessary packet to the unnecessary-packet area in the former transport stream, generated is a common custom transport stream including a plurality of the necessary packets contained in a plurality of transport streams originally different from each other as described above at a merged state.

[0043]

According to the second embodiment of the invention, effects similar to the first embodiment of the invention are exerted and, at the same time, the common custom transport stream can be efficiently generated since the former transport stream don't have to be divided by a unit of the packet and can be handled in the stream state without change.

[0044]

A digital broadcast receiving apparatus according to a third embodiment of the present invention is characterized in being configured so as to insert the transport stream packets extracted from both of the transport streams mutually after transport stream packet corresponding to necessary packet identifier in a transport stream are extracted and transport stream packet corresponding to necessary packet identifier in another transport stream are extracted.

[0045]

In this third embodiment of the invention, it is constituted so as to extract the necessary packets through dividing by a unit of the packet based on the necessary packet identifier with respect to both of the former transport stream and the latter transport stream. A common custom transport stream is generated through inserting the necessary packets extracted from the two transport streams mutually.

[0046]

According to the third embodiment of the invention, effects similar to the first embodiment of the invention are exerted and also it is possible in the generated custom transport stream to acquire a relatively large number of necessary packets for composing it. Specifically, in the second embodiment of the invention, since the necessary

packets are overwritten in the state where the stream form of the former transport stream is maintained, the probability and quantity that the unnecessary packets originally included in the former transport stream still remain is relatively large in the generated common custom transport stream. However, in the third embodiment of the invention where both the transport streams are divided into the necessary packets to extract it, a much more number of the necessary packets can be incorporated in the common custom transport stream.

[0047]

A digital broadcast receiving apparatus according to a fourth embodiment of the present invention is characterized in being configured so as to rewrite at least one of the packet identifiers to make them different from one another, when each of transport stream packets to be multiplexed by either the overwriting or the insertion have identical packet identifier, in the first to the third embodiments of the invention. This includes the case where the packet identifiers of the necessary packets in the latter transport stream are rewritten, the case where the packet identifiers of the necessary packets in the former transport stream are rewritten and a case where the packet identifiers in both of the transport streams are rewritten. In any one of the cases, it is assumed that rewriting is performed so that post-rewriting packet identifiers are not duplicated with packet identifiers of the remaining necessary packets or the unnecessary packets.

[0048]

According to the fourth embodiment of the invention, the packets from the plurality of transport streams, which are multiplexed in the common custom transport stream, are converted so as to have the relationship where the packet

identifiers are identifiable from one another, even when original packet identifiers are identical. Therefore, since the individual packet identifiers can be determined uniquely for all packets in the custom transport stream, desired packets can be acquired securely and accurately.

[0049]

The digital broadcast receiving apparatus according to a fifth embodiment of the invention is characterized being configured so as to rewrite the packet identifier of the transport stream packet on the side added newly through overwriting. This limits the fourth embodiment of the invention described above, and it is equivalent to the one that specifies the side where the packet identifier is rewritten as the packet identifier on the side added through overwriting.

[0050]

The operation of the fifth embodiment of the invention is as described below. Although the transport stream on the added side keeps the form of stream, packets on the adding side are already separated from the stream so as to be a unit of the packet. Therefore, the packet identifiers are rewritten much more efficiently.

[0051]

A digital broadcast receiving apparatus according to a sixth embodiment of the present invention, is characterized in being configured so as to prioritize NULL-packet area as the unnecessary-packet area corresponding to the unnecessary packet identifier, in the second, the fourth and fifth embodiments of the invention. This applies to the overwriting type as a mode of packet-multiplex.

[0052]

Operation of this sixth embodiment of the invention

is as follows. Since homogeneous or heterogeneous contents (elements) that are included in different transport streams are arbitrarily combined to thereby generate a common custom transport stream, the contents (elements) at the time randomly vary, which involves variations of unnecessary packet identifiers of packets included therein. Despite such variations, the overwriting can be efficiently performed through prioritizing NULL-packet area are as the unnecessary-packet area on the side added through the overwriting.

[0053]

A digital broadcast receiving apparatus according to a seventh embodiment of the present invention includes: unnecessary-packet detecting means for detecting unnecessary-packet areas corresponding to unnecessary packet identifiers in a transport stream that is inputted; necessary-packet extracting means for extracting transport stream packets corresponding to necessary packet identifiers in another transport stream that is inputted; and packet-overwriting means for overwriting transport stream packets extracted by the necessary-packet extracting means to the unnecessary-packet areas detected on the transport stream by the unnecessary-packet detecting means. This is equivalent to the one where the second embodiment of the invention has been described more specifically.

[0054]

Operation of the seventh embodiment of the invention is as follows. Based on unnecessary packet identifiers that are not necessary packet identifiers corresponding to the former transport stream, the unnecessary-packet detecting means detects unnecessary-packet areas to be made unnecessary in the former transport stream. Based on necessary packet identifiers corresponding to the latter

transport stream, the necessary-packet extracting means divides necessary packets the necessary packets from the latter transport stream to extract them. The packet-overwriting means overwrites the extracted necessary packets to the unnecessary-packet areas to be unnecessary in the former transport stream. Thereby, generated is a common custom transport stream including the plurality of necessary packets, which have been contained in the plurality of transport streams that are originally different from each other, in the merged state.

[0055]

According to the seventh embodiment of the invention, various rear-stage members such as a decoder and a digital interface, commencing with transport stream separating part can be simply structured corresponding to single-system transport streams. Further, the seventh embodiment of the invention makes unnecessary such high-frequency generating means as used in the conventional digital broadcast receiving apparatus (e.g., Japanese Unexamined Patent Application Publication No. 11-122556) in which the time-division multiplexing is performed at a frequency higher than the sum of transmission bit rates of individual transport streams. Also, since it is possible to handle higher-speed transport streams, the cost and size can be reduced overall. Additionally, since the former transport stream don't have to be divided by a unit of the packet, and can be used as the stream state without change, the common custom transport stream can be efficiently generated.

[0056]

A digital broadcast receiving apparatus according to an eighth embodiment of the present invention includes: necessary-packet extracting means for extracting transport stream packets corresponding to necessary packet

identifiers in a transport stream that is inputted; another necessary-packet extracting means for extracting transport stream packets corresponding to necessary packet identifiers in another transport stream that is inputted; and packet-inserting means for inserting both of the extracted transport stream packets mutually to thereby generate a new transport stream. This is equivalent to the one where the third embodiment of the invention is described more specifically.

[0057]

The operation of this eighth embodiment of the invention is as described below. Based on necessary packet identifiers corresponding to the former transport stream, the former necessary-packet extracting means divides necessary packets the necessary packets from the former transport stream to extract them. Based on necessary packet identifiers corresponding to the latter transport stream, the latter necessary-packet extracting means divides necessary packets from the latter transport stream to extract them. The packet-inserting means generates a common custom transport stream including the plurality of necessary packets, which are contained in the plurality of transport streams that are originally different from each other, in the merged state through inserting (assembling) former extracted necessary packets and latter extracted necessary packets mutually.

[0058]

According to this eighth embodiment of the invention, therefore, like the seventh embodiment of the invention described above, various rear-stage members such as a decoder and a digital interface, commencing with transport stream separating part can be simply structured corresponding to single-system transport stream. Further,

the eighth embodiment of the invention doesn't have to employ such high-frequency generating means as used in the above-mentioned publication in which the time-division multiplexing is performed at a frequency higher than the sum of transmission bit rates of individual transport streams. Also, since it is possible to handle higher-speed transport stream as a targeted transport stream, the cost and size can be reduced overall. Additionally, since both of the transport streams are divided into the necessary packets to extract them, a much larger number of the necessary packets can be incorporated into the common custom transport stream.

[0059]

A digital broadcast receiving apparatus according to a ninth embodiment of the present invention characterized in comprising the next in the seventh and the eight embodiments of the invention: identical packet identifier determining means for performing determination whether both of the transport stream packets to be multiplexed with each other through the overwriting or the insertion, have identical packet identifiers; and packet identifier converting means for performing rewriting at least one of packet identifiers of packets so that opponent-side packet identifiers are differentiated for transport stream packets that are determined by the identical packet identifier determining means. This is equivalent to the one where the fourth embodiment of the invention that is described more specifically.

[0060]

The operation of this ninth embodiment of the invention is as described below. The identical packet identifier determining means determines whether each of the necessary packets to be multiplexed has identical packet

identifier with each other. When it finds identical packet identifiers, it feeds the determination result to the packet identifier converting means. Based on the determination result, the packet identifier converting means performs rewriting of packet identifiers and adjusts them so as to be different from one another for all the necessary packets. Thereafter, a common custom transport stream is generated through executing overwriting as is done in the seventh embodiment of the invention, or executing insertion as is done in the eighth embodiment of the invention. As a result, for all packets multiplexed in the common custom transport stream, each of the packet identifiers can be uniquely determined. Therefore, desired packets can be acquired securely and accurately.

[0061]

A digital broadcast receiving apparatus according to a tenth embodiment of the present invention is characterized in comprising: NULL-packet counting means for counting NULL packets from the transport stream on the side receiving overwriting; packet counting means for counting transport stream packets after extraction on the side added through the overwriting; comparing means for comparing a NULL-packet count value obtained by the NULL-packet counting means with a transport stream packet count value obtained by the packet counting means; and NULL-packet-priority specifying means for specifying NULL-packet area with priority as unnecessary-packet area corresponding to the unnecessary packet identifiers when the former count value is equal to or greater than the latter count value, in the seventh and the ninth embodiments of the invention. This is equivalent to the one where the sixth embodiment of the invention is described more specifically.

[0062]

The operation of the tenth embodiment of the invention is as follows. The NULL-packet counting means counts the NULL packets in the transport stream on the side receiving overwriting; the packet counting means counts the transport stream packets after extraction on the side added through the overwriting; the comparing means compares the former NULL-packet count value (represented by "C_{NULL}") with the latter extracted-packet count value (represented by "C_{NP}"); and overwriting is performed to NULL-packet area with priority when $C_{NULL} \geq C_{NP}$, i.e., when the number of the NULL packets to be overwritten is sufficient. As a result, the overwriting can be efficiently performed.

[0063]

A digital broadcast receiving apparatus according to an eleventh embodiment of the present invention is characterized in being constituted so that the packet-overwriting means makes the NULL-packet area to be an overwriting objects by priority when a detection frequency of NULL packets on the transport stream on the side receiving overwriting is high,; and concurrently, when overwriting of the extracted transport stream packets to NULL packets is suspended, and the number of packets in standby for the overwriting reaches a predetermined value, the overwriting thereof is executed to other unnecessary-packet areas, in the seventh and the ninth embodiments of the invention. This is also equivalent to the one where the sixth embodiment of the invention is described more specifically.

[0064]

The operation of this eleventh embodiment of the invention is as described below. The packet-overwriting means detects NULL packets in the transport stream on the

side receiving overwriting. When the detection frequency thereof is relatively high, that is, the number of the NULL packets is sufficient, the packet-overwriting means performs overwriting directly to the NULL-packet areas with priority without performing the specific processing as described below. However, when the detection frequency of the NULL packets is relatively low, namely,, the number of the NULL packets to be overwritten is short, the overwriting is suspended, and the number of packets in standby for the overwriting is thereby increased. In the case where the number of the standby packets is equal to or larger than a predetermined value, when the overwriting is performed only to the NULL-packet areas, packets on the side where packets are added in predetermined time interval tend to excessively concentrate. Therefore, in order to avoid the above phenomenon, the overwriting thereof is permitted to unnecessary-packet areas other than the NULL-packet areas, when the number of the pending packets reaches the predetermined value. Thereby, the packets on the side added within the predetermined time interval on the common custom transport stream can be appropriately dispersed for arranging, which makes the rear-stage transport stream separating processing to be advantageous.

[0065]

In the first to the eleventh embodiments of the invention, a digital broadcast receiving apparatus according to a twelfth embodiment of the present invention characterized in being configured so that a plurality of transport streams selected arbitrarily from the ones listed below is aimed at as a plurality of transport streams including packets multiplexed through the overwriting or the insertion,

(a) a transport stream including viewing-request

broadcast program data,

(b) a transport stream including data relevant to broadcast program table,

(c) a transport stream including downloadable data,

(d) a transport stream including image-recording-request broadcast program data,

(e) a transport stream including data broadcast program data, and

(f) a transport stream including other broadcast program data;

and packets in the plurality of transport streams selected are multiplexed. This is equivalent to the one where each of the above-described embodiments of the invention is described from another angle.

[0066]

According to the twelfth embodiment of the invention, it is possible that the digital-broadcast reception mode is significantly enriched in variety as already described. Herewith, regardless of whether or not transport stream includes information such as a broadcast program accompanying an image/audio, a broadcast program table, downloadable data and a data broadcast such as an electronic music delivery, which are transmitted from the digital-broadcast transmitting apparatus, diversified services such as screen-viewing, broadcast program table display, downloading, data-broadcast reception, multi-screen display can be achieved in an arbitrary combination and at the same time.

[0067]

Namely, digital-broadcast reception enriched in variety can be implemented like that, for example, a broadcast program table included in a transport stream different from a transport stream including the

aforementioned broadcast program is displayed, while a broadcast program is viewed; a broadcast program included in another transport stream is image-recorded, while a broadcast program is viewed; data such as a program included in another transport stream is downloaded, while a broadcast program is viewed; data broadcast program included in another transport stream is received, while a broadcast program is viewed; data such as a program included in another transport stream is downloaded, while a broadcast program is image-recorded; data broadcast program included in another transport stream is received, while a broadcast program is image-recorded; and data such as a program included in another transport stream is downloaded, while a data broadcast program is received.

[0068]

Hereinafter, the digital broadcast receiving apparatus according to specific embodiments of the present invention will be described in detail with reference to the drawings.

[0069]

(Embodiment 1)

The first embodiment is configured so that the packets of arbitrary programs (contents) in a plurality of transport streams (TS) in digital broadcasting are multiplexed through "overwriting". As an example of operation, the multiplexing of a broadcast program during viewing and a broadcast program table is described below.

[0070]

Fig. 1 is a block diagram showing an electrical configuration of a digital broadcast receiving apparatus according to the first embodiment of the present invention. Fig. 1 is common in second to sixth embodiments described later. Fig. 2 is a block diagram showing a specific

configuration of a multiplexer section according to the first embodiment.

[0071]

In Fig. 1, reference numeral 101_i (i = 1, 2,...n) denotes a plurality of first to n-th tuners provided corresponding to modulated waves of different channels (transmission paths), numeral 102_i denotes a plurality of first to n-th demodulator sections provided for outputting each transport stream (TS) according to MPEG2 by demodulating and performing an error correction simultaneously in a state corresponding to a modulation scheme defined with each digital broadcasting system, numeral 103 denotes a multiplexer section for generating one new custom transport stream (CTS) by multiplexing transport stream packets extracted based on necessary packet identifiers (PID) designated by a user in a plurality of input transport streams (TS), numeral 104 denotes a transport stream separating section (TD) for separating and extracting aimed transport stream packets designated by the user from a custom transport stream (CTS) inputted from the multiplexer section 103, numeral 105 denotes an image decoder for generating image information by expanding and decoding an image stream generated anew by separation, numeral 106 denotes an image synthesizer for generating an image signal by synthesizing image information and service information, numeral 107 denotes an audio decoder for expanding and decoding an audio stream generated anew by separation and then converting it into an analog signal thereby to generate an audio signal, numeral 108 denotes a digital interface (such as an IEEE 1394) for outputting transport information separated, numeral 109 denotes a CPU for controlling the whole apparatus, numeral 110 denotes a ROM (read-only memory) for storing a program,

numeral 111 denotes a RAM (random access memory) as a working memory, numeral 112 denotes an input section such as buttons on a front panel and a remote control transmitter, and numeral 113 denotes a bus for connecting the CPU 109 to various parts as shown in the drawing. A rewritable nonvolatile memory such as a flash memory is preferable as the ROM 110 but not necessarily use it. The digital broadcast receiving apparatus according to this embodiment is configured as described above. Fig. 1 also shows a monitor 801 for generating and displaying an image from an image signal connected to the image synthesizer 106, a speaker 802 connected to the audio decoder 107 for outputting by converting an audio signal into an audio, and a digital recording device 803 connected to the digital interface 108 for recording transport information.

[0072]

Also, in Fig. 2 showing a specific configuration of the multiplexer section 103, numeral 201 designates a first necessary packet identifier table for viewing to register packet identifiers (PID) necessary for extracting necessary packets for a viewing-request broadcast program from a first transport stream TS_1 outputted from the first demodulator section 102_1, by user designation, numeral 202 designates an unnecessary packet detector section for extracting an unnecessary packet identifier that is the packet identifier (PID) for the unnecessary packet in the first transport stream TS_1 based on the comparison of the packet identifier (PID) registered in the first necessary packet identifier table 201 for viewing with the packet identifier (PID) of the transport stream packet included in the first transport stream TS_1 and detecting an unnecessary packet area corresponding to the unnecessary packet identifier, numerals 203_2 to 203_n designates second to n-th

transport stream packet extracting sections for extracting the necessary packets of a content concerning the user's designation from the transport streams TS_2 to TS_n outputted respectively from the second to n-th demodulator sections 102_2 to 102_n, numerals 204_2 to 204_n designates second to n-th necessary packet identifier tables for registering packet identifiers (PID) necessary in extracting necessary packets for a content of which acquisition is desired respectively from the second to n-th transport streams TS_2 to TS_n, by user designation, and numeral 205 designates a transport stream packet overwriting section.

[0073]

Next, the operation of the digital broadcast receiving apparatus according to the first embodiment configured as mentioned above is described with reference to the flowchart of Fig. 3 and the operation diagram of Fig. 4. Here, as an example of the operation to be described, it is assumed that the number of the transport streams (TS) in CS digital broadcasting to be fetched in is two. The first transport stream TS_1 is assumed to be a transport stream where the video signal, the audio signal and the data signal in the broadcast program during viewing are included, and the second transport stream TS_2 is assumed to be a transport stream wherein the broadcast program layout information (SI) making up the broadcast program table of schedule is included. Specifically, the operation is described for realizing the viewing of the broadcast program during viewing and the import (display) of the broadcast program table at the same time when the broadcast program during viewing and the broadcast program table are transmitted in different transport streams.

[0074]

(Step 1)

The CPU 109 registers the packet identifier (PID) of the transport stream packet including the video signal, the audio signal and the data signal, i.e. the elementary stream (ES) signal making up the viewing-desired program and the packet identifier (PID) of the transport stream packet including the program specification information (PSI) for the viewing-request program and the broadcast program layout information (SI), in the first packet identifier table 201 for viewing corresponding to the first transport stream TS_1, based on user setting information set in the input section 112 and in accordance with the program in the ROM 110, when the user sets a viewing-request program in the input section 112.

[0075]

There are a network information table (NIT), a program association table (PAT), a program map table (PMT) and an entitlement control message (ECM) as the program specification information (PSI).

[0076]

There is an event information table (EIT) needed for presentation of information concerning a program such as a name, time/date and contents of the program as the broadcast program layout information (SI). The packet identifier (PID) is "0x0012", where "0x" indicates the hexadecimal display.

[0077]

Describing the above more specifically, the network information table (NIT) mentioned above is the one for associating transmission path information with an organization channel, and has the packet identifier (PID) of "0x0010". The program association table (PAT) is the one for acquiring the packet identifier (PID) of the transport stream packet for transmitting the program map

table (PMT) and its packet identifier (PID) is "0x0000". The broadcast program table (PMT) is the one for acquiring the packet identifier (PID) of the transport stream packet for transmitting the video signal, audio signal and data signal for making up a broadcast program, and its packet identifier (PID) is described in the program association table (PAT). The entitlement control message (ECM) is the one for descrambling a broadcast program and its packet identifier (PID) is described in the program map table (PMT).

[0078]

The NIT is configured as follows. For a transport stream number "1", a transmission source is a transverse electric of 11.20 GHz; and service number lists are "3", "5", …. For a transport stream number "2", a transmission source is a transverse electric of 11.23 GHz; and service number lists are represented by "9", "10", …. The network information table (NIT) is retransmitted every second. The same NIT is transmitted in all the transport streams (TS). This operation is constantly monitored by the digital broadcast receiving apparatus.

[0079]

As the structure of the program association table (PAT), the packet identifier (PID) of the program map table (PMT) for the service number "3ch", for example, is described as "0x21", and the packet identifiers (PID) of the program map tables (PMT) for the service numbers "5ch", "7ch" are described as "0x21", "0x22", respectively. The program association table (PAT) is retransmitted every 100 msec. This is carried out for corresponding to the updating of the PAT due to a service change, and it is constantly monitored by the digital broadcast receiving apparatus.

[0080]

As the structure of the program map table (PMT), the packet identifier (PID) of the elementary stream (ES) for "video #1", for example, is described as "0x30", the packet identifier (PID) of the entitlement control message (ECM) is described as "0x40", the packet identifier (PID) of the elementary stream (ES) for "audio #1" is described as "0x31", and the packet identifier (PID) of the entitlement control message (ECM) is described as "0x41". The program map table (PMT) is retransmitted every 100 msec. This is carried out for corresponding to the PMT updating due to a change in the elementary stream (ES), and it is constantly monitored by the digital broadcast receiving apparatus.

[0081]

Furthermore, the packet identifiers (PID) of NIT, PAT, EIT are fixed values, while the packet identifiers (PID) of PMT, ECM, video signal and audio signal are variable.

[0082]

In Fig. 4, the packet identifier (PID) of the network information table (NIT) is abbreviated as PI. Similarly, it is abbreviated like the packet identifier (PID) of the program association table (PAT) as P2, the packet identifier (PID) of the program map table (PMT) as P3, the packet identifier (PID) of the entitlement control message (ECM) as P4, the packet identifier (PID) of the video signal of the broadcast program being viewed as P5, the packet identifier (PID) of the audio signal of the broadcast program being viewed as P6, and the packet identifier (PID) of the event information table (EIT) as P7,respectively. In this step 1, these packet identifiers (PID) P1 to P7 are registered in the first necessary packet identifier table 201 for viewing.

[0083]

(Step 2)

The user executes operation for giving an instruction to display a broadcast program table in the input section 112. The broadcast program table means a list of digital broadcast programs for one or two weeks.

[0084]

(Step 3)

The CPU 109 gives a command to the second tuner 101_2 to switch to a transponder to which the broadcast program layout information (SI) making up the broadcast program table is transmitted, based on the instruction from the input section 112. Here, the broadcast program layout information (SI) making up the broadcast program table is a schedule EIT in concrete terms. Namely, the CPU 109 analyzes the network information table (NIT) sent out by all the transponders. This network information table (NIT) is acquired from the first transport stream TS_1 for the broadcast program during viewing. This acquisition is performed in the transport stream separating section 104. As a result of analyzing the network information table (NIT), the identifier (transport stream id) of the transport stream (TS) to which the schedule EIT is sent is searched, and the transmission path information corresponding to the transport identifier (tsi) is acquired and set in the second tuner 101_2, while at the same time activating the second demodulator section 102_2. The modulated wave of the channel selected by the second tuner 101_2 is demodulated into the transport stream (TS) according to MPEG2 by the second demodulator section 102_2 and outputted to the second transport stream packet extracting section 203_2. This is the second transport stream TS_2 including the broadcast program table.

[0085]

Moreover, the transport stream (TS) including the broadcast program table may be received with another tuner (any one of 101_3 to 101_n).

[0086]

(Step 4)

The CPU 109 registers the event information table (EIT), i.e. in the present case, the packet identifier (PID) ("0x0012") of the schedule EIT in the second necessary packet identifier table 204_2 for the second tuner 101_2. In Fig. 4, the packet identifier (PID) of the schedule EIT is abbreviated as P7.

[0087]

(Step 5)

The second transport stream packet extracting section 203_2, to which the second transport stream TS_2 is inputted, extracts the transport stream packet having the packet identifier (PID) registered in the second necessary packet identifier table 204_2, i.e. in the present case, the transport stream packet having the packet identifier (PID) (= P7) of the schedule EIT from the second transport stream packet TS_2, and outputs it to the transport stream packet overwriting section 205 as a necessary packet NecesP.

[0088]

In Fig. 4, only the necessary packet NecesP with the packet identifier (PID) P7, i.e. only the packet of the schedule EIT is extracted, and outputted it to the transport stream packet overwriting section 205.

[0089]

(Step 6)

The unnecessary packet detector section 202 compares the inputted first transport stream TS_1 with the first necessary packet identifier table 201 for viewing, and detects the transport stream packet having the packet

identifier (PID) not registered in the first necessary packet identifier table 201 for viewing in the first transport stream TS_1. Then, the detection result, i.e. the unnecessary packet detection information Unneces is given to the transport stream packet overwriting section 205.

[0090]

In Fig. 4, the unnecessary packet area TSoo with P10, P11, P12 as the packet identifiers (PID) in the first transport stream TS_1 is not corresponded to any of the packet identifiers (PID) P1 to P7 registered in the first necessary packet identifier table 201 for viewing, and the unnecessary packet detector section 202 generates the unnecessary packet detection information Unneces for the unnecessary packet area TSoo with P10, P11, P12 as the packet identifiers (PID) and outputs it to the transport stream packet overwriting section 205.

[0091]

(Step 7)

The transport stream packet overwriting section 205 is supplied with the first transport stream TS_1 from the first demodulator section 102_1 and the unnecessary packet detection information Unneces from the unnecessary packet detector section 202. Further, it is supplied with the necessary packet NecesP after extraction (i.e. the packet of the event information table (EIT) corresponding to the packet identifier (PID) = P7) from the second transport stream packet extracting section 203_2 so that buffering is carried out. The transport stream packet overwriting section 205 overwrites the necessary packet NecesP (i.e. the packet of the event information table (EIT) corresponding to the packet identifier (PID) = P7) extracted from the second transport stream TS_2 to the unnecessary packet area TSoo in the first transport stream

TS_1 instructed by the unnecessary packet detection information Unneces, and further buffers the new one transport stream generated by the overwriting.

[0092]

In Fig. 4, the transport stream packet of the event information table (EIT) with the packet identifier (PID) of P7 which is the necessary packet NecesP extracted from the second transport stream TS_2 is overwritten to the unnecessary packet area TSoo with the packet identifier (PID) of P10 in the first transport stream TS_1. Also, the transport stream packet of EIT with the packet identifier (PID) P7 is similarly overwritten to the unnecessary packet area TSoo with the packet identifiers (PID) of P11, P12.

[0093]

(Step 8)

A new one custom transport stream (CTS) buffered in an updated manner after being overwritten in the transport stream packet overwriting section 205 as described above is sequentially outputted to the transport stream separating section 104.

[0094]

According to the sequential operation described above, the custom transport stream (CTS) includes also the broadcast program layout information (SI) for configuring the broadcast program table in addition to the video signal, audio signal and data signal for the broadcast program during viewing.

[0095]

The operation of the transport stream separating section 104, and the image decoder 105, the image synthesizer 106 and the audio decoder 107 at a subsequent stage is similar to that of the prior art. Specifically, the transport stream separating section 104 separates the

transport stream packet of the video signal of the program designated by the user from the custom transport stream (CTS), and outputs it freshly as an image stream to the image decoder 105. At the same time, the transport stream packet of the audio signal of the program is separated and outputted it freshly as a new audio stream to the audio decoder 107. Also, the transport stream separating section 104 transfers the broadcast program layout information (SI) making up the broadcast program table to the RAM 111. The CPU 109 transfers the broadcast program layout information (SI) stored in the RAM 111 to the image synthesizer 106. The image decoder 105 expands and decodes the image stream, to generate the image information, and sends it out to the image synthesizer 106. The image synthesizer 106 synthesizes the image information and the information on the broadcast program table, converting them into analog image signals, and then outputs it to the monitor 801. Also, the audio decoder 107 expands and decodes the audio stream, further converts it into analog audio signals, and then outputs it to the speaker 802.

[0096]

In addition, although the multiplexing of the data on the broadcast program during viewing and the broadcast program layout information (SI) making up the broadcast program table is exemplified in the foregoing description of the operation, it is possible to multiplex in arbitrary combination of any arbitrary ones of program data during viewing, broadcast program layout information (SI), image-recording-desired program data, downloadable data and data broadcast program data other than this. For example, there are a combination of screen-viewing and image-recording, a combination of screen-viewing and downloading, a combination of screen- and data broadcast receiving, a

combination of image-recording and downloading, a combination of one screen-viewing and the other one in multiscreen display, a combination of image-recording and data broadcast receiving, a combination of one image-recording and another image-recording, a combination of downloading and data broadcast receiving, a combination of one downloading and another downloading, and a combination of one data broadcast receiving and another data broadcast receiving. Further, in addition to each of the combinations described above, several other ones may also be multiplexed. Specifically, not only two input transport streams (TS) but also three or more input transport streams (TS) can be combined for multiplexing.

[0097]

Figs. 5 to 8 show an example of combinations of a variety of receiving forms. Fig. 5 shows the appearance in which screen-viewing and image-recording are combined, Fig. 6 the appearance in which screen-viewing and downloading are combined, Fig. 7 the appearance in which screen-viewing and data broadcast program receiving are combined, and Fig. 8 the appearance in which one screen-viewing and another screen-viewing are combined.

[0098]

(Embodiment 2)

The second embodiment is configured so that arbitrary programs (contents) in a plurality of transport streams (TS) in the digital broadcasting are multiplexed by overwriting, and in the case where the packet identifiers (PID) of the packets to be multiplexed are identical with each other, they are multiplexed after being converted into another packet identifier (PID). The multiplexing of a broadcast program during viewing and an image-recording-request program is taken up as an example of operation.

[0099]

Fig. 1 shows a basic configuration common in the digital broadcast receiving apparatus according to the second embodiment. Fig. 9 is a block diagram showing a specific configuration of the multiplexer section according to the second embodiment.

[0100]

In Fig. 9, reference numeral 301 denotes a packet identifier extracting section for extracting all the packet identifiers (PID) included in the first transport stream TS_1 inputted from the first demodulator section 102_1, numeral 302 denotes an existing packet identifier table for registering all the packet identifiers (PID) extracted by the packet identifier extracting section 301, numeral 303 denotes an identical packet identifier determining section for determining whether or not the packet identifier (PID) of the necessary packet NecesP after extraction extracted by the second to n-th transport stream packet extracting sections 203_2 to 203_n is identical with any of the packet identifiers (PID) registered in the existing packet identifier table 302, and numeral 304 denotes a packet identifier converting section configured so that the necessary packet NecesP after extraction is converted into another packet identifier (PID) not registered in the existing packet identifier table 302, when the result of determination of the identical packet identifier determining section 303 is "identical", and sends out the necessary packet NecesP involving the packet identifier (PID) thus converted to the transport stream packet overwriting section 205, while the necessary packet NecesP after extraction is sent out by through directly without packet identifier (PID) conversion, when the result of determination that both are different from each other is

obtained on the contrary. The other parts of the configuration are similar to those of the first embodiment (Fig. 2) and the same components are designated by the same reference numerals respectively, description thereof is omitted.

[0101]

Next, the operation of the digital broadcast receiving apparatus according to the second embodiment configured as described above is described with reference to the flowcharts of Figs. 10 to 13 and the operation diagrams of Figs. 14 to 16. In this case, as an example of operation, it is assumed that the number of the transport streams (TS) in the CS digital broadcasting to be fetched in is two. It is assumed that the first transport stream TS_1 is the one including the broadcast program during viewing, and the second transport stream TS_2 is the one including the image-recording-request program. Specifically, described is the operation in screen-viewing of a broadcast program during viewing and image-recording of an image-recording-request program are realized at the same time when the broadcast program during viewing and the image-recording-request program are transmitted in transport streams different from each other.

[0102]

(Step 1)

The user sets a viewing-request program in the input section 112. Then, the CPU 109, based on the user-setting information set through the input section 112, registers the packet identifier (PID) of the transport stream packet including the video signal, the audio signal and the data signal making up the viewing-desired program, i.e. the elementary stream (ES) signal and the packet identifier (PID) of the transport stream packet including the program

specification information (PSI) and the broadcast program layout information (SI) for the broadcast program during viewing, in the first necessary packet identifier table 201 for viewing corresponding to the first transport stream TS_1.

[0103]

There are a network information table (NIT), a program association table (PAT), a program map table (PMT) and an entitlement control message (ECM) as the program specification information (PSI), while there are an event information table (EIT) required for presentation of information on a broadcast program such as name, time/date and contents of the program as the broadcast program layout information (SI). As a result, as shown in Fig. 14, P1 or the packet identifier (PID) of the network information table (NIT), P2 or the packet identifier (PID) of the program association table (PAT), P3 or the packet identifier (PID) of the program map table (PMT), P4 or the packet identifier (PID) of the entitlement control message (ECM), P5 or the packet identifier (PID) of the video signal of the broadcast program during viewing, P6 or the packet identifier (PID) of the audio signal of the broadcast program during viewing, and P7 or the packet identifier (PID) of the event information table (EIT) are registered in the first necessary packet identifier table 201 for viewing. In other words, the packet identifiers (PID) P1 to P7 are registered in the first necessary packet identifier table 201 for viewing.

[0104]

(Step 2)

The user performs an operation to select an image-recording-request program in the input section 112.

[0105]

(Step 3)

The CPU 109 determines whether the image-recording-request program is included in the same transport stream where the broadcast program during viewing is contained. In the case where the image-recording-request program is included there, the process proceeds to step 4, otherwise the process proceeds to step 10.

[0106]

(Step 4)

According to judgment in step 3, when the image-recording-request program is included in the first transport stream TS_1 of the broadcast program during viewing, the process proceeds to step 4 to acquire the packet identifier (PID) of the program map table (PMT) for the image-recording-request program from the program association table (PAT) in the first transport stream TS_1 that is received at present.

[0107]

(Step 5)

Based on the packet identifier (PID) acquired in step 4, the program map table (PMT) for the image-recording-request program is received, from which the packet identifiers (PID) of the entitlement control message (ECM), the video signal and the audio signal for the image-recording-request program are acquired.

[0108]

(Step 6)

Based on the packet identifiers (PID) acquired in step 5, the entitlement control message (ECM), the video signal and the audio signal for the image-recording-request program are received.

[0109]

(Step 10)

When it is determined that the image-recording-

desired program is not included in the first transport stream TS_1 of the broadcast program during viewing based on judgment in step 3, the process proceeds to step 10, and the packet identifier extracting section 301 extracts all the packet identifiers (PID) included in the first transport stream TS_1 inputted from the first demodulator section 102_1 and registers all the extracted packet identifiers (PID) in the existing packet identifier table 302. In Fig. 14, P1 to P7, P20, P22, P24, P26, P28 and P29 are registered as packet identifiers (PID).

[0110]

(Step 11)

The CPU 109 switches to the transponder to which the desired image-recording-request program is transmitted. Specifically, by analyzing the network information table (NIT) acquired from the first transport stream TS_1 of the broadcast program being viewed, the identifier (transport stream id) of the transport stream including the image-recording-request program is detected, and the transmission path information corresponding to the transport stream identifier (tsi) is acquired to set it in the second tuner 101_2, while at the same time the second demodulator section 102_2 is activated. The modulated wave of the channel selected by the second tuner 101_2 is demodulated into a transport stream (TS) according to MPEG2 by the second demodulator section 102_2, and outputted to the second transport stream packet extracting section 203_2. This is a second transport stream TS_2 including the image-recording-request program.

[0111]

Furthermore, the transport stream (TS) including the image-recording-request program can be received with another tuner (any one of 101_3 to 101_n).

[0112]

(Step 12)

The CPU 109, as shown in Fig. 14, registers P2 or the packet identifier of the upper program association table (PAT) in the program specification information (PSI) of the image-recording-request program and P7 or the packet identifier (PID) of the event information table (EIT) equivalent to the broadcast program layout information (SI) in the second necessary packet identifier table 204_2 for the second tuner 101_2.

[0113]

It should be noted here that the packet identifier (PID) of the program association table (PAT) and the packet identifier (PID) of the event information table (EIT) have a common data value with respect to the broadcast program during viewing and the image-recording-request program. In other words, the packet identifiers (PID) are overlapped with each other. Specifically, both the first necessary packet identifier table 201 and the second necessary packet identifier table 204_1 become P2, P7.

[0114]

(Step 13)

The second transport stream packet extracting section 203_2 to which the second transport stream TS_2 is inputted extracts the transport stream packet having the packet identifiers (PID) registered in the second necessary packet identifier table 204_2, i.e. here, the packet identifiers (PID) of the program association table (PAT) and the event information table (EIT) from the second transport stream TS_2, and outputs them as the necessary packets NecesP to the identical packet identifier determining section 303 and the packet identifier converting section 304.

[0115]

In Fig. 14, only the necessary packets NecesP with the packet identifiers P2 and P7, i.e. only the packets of the program association table (PAT) and the event information table (EIT) are extracted.

[0116]

(Step 14)

The identical packet identifier determining section 303 determines whether P2 and P7, that is the packet identifiers (PID) of the necessary packets NecesP inputted from the second transport stream packet extracting section 203_2, are identical with the packet identifiers (PID) registered in the existing packet identifier table 302, and the process proceeds to step 15 when identical packet identifiers are registered, otherwise, it proceeds to step 16.

[0117]

(Step 15)

, the process proceeds to step 15, and th When the packet identifier (PID) of the packet extracted by the second transport stream packet extracting section 203_2 overlaps with the packet identifier (PID) in the first transport stream TS_1 in judgment by the identical packet identifier determining section 303 in step 14e packet identifier converting section 304 converts P2, P7 which are the packet identifiers (PID) of the extracted packets into other packet identifiers (PID) distinguishable from each other and not registered in the existing packet identifier table 302. In Fig. 14, as an example, it is assumed that P2 and P7 are converted into P32 and P37 respectively. Then, the necessary packets NecesP of the program association table (PAT) and the event information table (EIT) involving P32, P37 that are the packet identifiers (PID) after the conversion are sent out to the transport

stream packet overwriting section 205.

[0118]

(Step 16)

The unnecessary packet detector section 202 compares the inputted first transport stream TS_1 with the first necessary packet identifier table 201 for viewing, and detects the transport stream packet having a packet identifier not registered in the first necessary packet identifier table 201 for viewing in the first transport stream TS_1. The unnecessary packet detection information Unneces that is a result of the detection is supplied to the transport stream packet overwriting section 205.

[0119]

In Fig. 14, the unnecessary packet area TSoo where the packet identifiers (PID) are P20, P29 in the first transport stream TS_1 corresponds to none of P1 to P7 of the packet identifiers (PID) registered in the first necessary packet identifier table 201 for viewing, and the unnecessary packet detector section 202 generates unnecessary packet detection information Unneces with respect to the unnecessary packet area TSoo where the packet identifiers (PID) are P20, P29, and outputs it to the transport stream packet overwriting section 205.

[0120]

(Step 17)

The transport stream packet overwriting section 205, to which the first transport stream TS_1 is inputted from the demodulator section 102_1 and also the unnecessary packet detection information Unneces is inputted from the unnecessary packet detector section 202, further the necessary packet NecesP extracted by the second transport stream packet extracting section 203_2 and then converted to the packet identifier with the packet identifier converting

section 304 is inputted, buffers them. And, the transport stream packet overwriting section 205 overwrites the necessary packet NecesP extracted from the second transport stream TS_2 to the unnecessary packet area TSoo in the first transport stream TS_1 indicated by the unnecessary packet detection information Unneces, and buffers the one transport stream generated newly by the overwriting.

[0121]

In Fig. 14, the transport stream packet of the program association table (PAT) with the packet identifier (PID) of P32 that is the necessary packet NecesP extracted from the second transport stream TS_2 is overwritten to the unnecessary packet area TSoo with the packet identifier (PID) of P20 in the first transport stream TS_1. Also, the transport stream packet of the event information table (EIT) with the packet identifier (PID) of P37 is similarly overwritten to the unnecessary packet area TSoo with the packet identifier (PID) of P29.

[0122]

(Step 18)

A new one custom transport stream (CTS) updated and buffered after overwriting in the transport stream packet overwriting section 205 as described above is sequentially outputted to the transport stream separating section 104.

[0123]

(Step 19)

The packet identifier (PID) of the program map table (PMT) for the image-recording-desired program is acquired from the program association table (PAT) in the second transport stream TS_2 including the image-recording-request program during currently viewing. The acquisition is carried out in the transport stream separating section 104....

[0124]

(Step 20)

The packet identifier (PID) of the program map table (PMT) acquired in step 19 is registered in the second necessary packet identifier table 204_2. In Fig. 15, as an example, the packet identifier (PID) of the program map table (PMT) is assumed to be P10. Herewith, P2, P7 and P10, which are the packet identifiers (PID) of the program association table (PAT), the event information table (EIT) and the program map table (PMT) for the image-recording-desired program, are registered in the second necessary packet identifier table 204_2.

[0125]

It should be noted here that the packet identifiers (PID) of the program map table (PMT) is generally different such as P3 and P10 for the broadcast program during viewing and the image-recording-request program, however, it may happen to be identical with each other.

[0126]

(Step 21)

The second transport stream packet extracting section 203_2 to which the second transport stream TS_2 is inputted extracts the transport stream packet having the packet identifiers (PID) registered in the second necessary packet identifier table 204_2, i.e. the packet identifiers (PID) of the program association table (PAT), the event information table (EIT) and the program map table (PMT) from the second transport stream TS_2, and outputs it to the identical packet identifier determining section 303 and the packet identifier converting section 304 as the necessary packet NecesP.

[0127]

In Fig. 15, only the necessary packets NecesP with the packet identifiers (PID) of P2, P7 and P10, i.e. only

the packets in the program association table (PAT), the event information table (EIT) and the program map table (PMT) are extracted.

[0128]

(Step 22)

The identical packet identifier determining section 303 determines whether P2, P7, P10, which are the packet identifiers (PID) of the necessary packets NecesP inputted from the second transport stream packet extracting section 203_2, are those registered in the existing packet identifier table 302. When the packet identifiers are registered there, the process proceeds to step 23, otherwise, it proceeds to step 24. Here, the process proceeds to step 23 in the case of P2 and P7, and skips to step 24 in the case of P10.

[0129]

(Step 23)

In the case where the identical packet identifier determining section 303 determines in step 22 that the packet identifier (PID) of the packet extracted by the second transport stream packet extracting section 203_2 overlaps with the packet identifier (PID) in the first transport stream TS_1, then the process proceeds to step 23, in which the packet identifier converting section 304 converts P2, P7 which are the packet identifiers (PID) of the extracted packets into other packet identifiers (PID) distinguishable from each other and not registered in the existing packet identifier table 302. In Fig. 15, as an example, it is assumed that P2 is converted into P32 as in the aforementioned case, and P7 is converted into P37 as in the aforementioned case.

[0130]

Here, when P10 is identical with P3, P10 is also

subject to packet identifier conversion.

[0131]

(Step 24)

Then, the necessary packets NecesP of the program association table (PAT) and the event information table (EIT) involving P32, P37 that are the packet identifiers (PID) after the conversion and the necessary packet NecesP of the program map table (PMT) with the packet identifier (PID) of P10 that is not converted, are sent out to the transport stream packet overwriting section 205.

[0132]

(Step 25)

The unnecessary packet detector section 202 compares the inputted first transport stream TS_1 with the first necessary packet identifier table 201 for viewing, and detects the transport stream packet having the packet identifier (PID) not registered in the first necessary packet identifier table 20 for viewing in the first transport stream TS_1. Then, the detection result, i.e. the unnecessary packet detection information Unneces is supplied to the transport stream packet overwriting section 205.

[0133]

In Fig. 15, the unnecessary packet area TSoo with the packet identifiers (PID) of P20, P22, P29 in the first transport stream TS_1 is associated with none of the packet identifiers P1 to P7 registered in the first necessary packet identifier table 201 for viewing, so that the unnecessary packet detector section 202 generates the unnecessary packet detection information Unneces for the unnecessary packet area TSoo with the packet identifiers (PID) of P20, P22, P29 and outputs it to the transport stream packet overwriting section 205.

[0134]

(Step 26)

The transport stream packet overwriting section 205 receives supply of the first transport stream TS_1 from the demodulator section 102_1, the unnecessary packet detection information Unneces from the unnecessary packet detector section 202, and further the necessary packets NecesP extracted by the second transport stream packet extracting section 203_2 and subject to packet identifier conversion by the packet identifier converting section 304 and the necessary packets NecesP not subject to packet identifier conversion to buffer them. Then, the transport stream packet overwriting section 205 overwrites the necessary packets NecesP extracted from the second transport stream TS_2 to the unnecessary packet area TSoo in the first transport stream TS_1 indicated by the unnecessary packet detection information Unneces, and the new one transport stream thus generated by the overwriting is further buffered.

[0135]

In Fig. 15, the transport stream packet of the program association table (PAT) with the packet identifier (PID) of P32 that is the necessary packet NecesP extracted from the second transport stream TS_2 is overwritten to the unnecessary packet area TSoo with the packet identifier (PID) of P20 in the first transport stream TS_1. Similarly, the transport stream packet of the program map table (TM) with the packet identifier (PID) of P10 is overwritten to the unnecessary packet area TSoo with the packet identifier (PID) of P22. Further, the transport stream packet of the event information table (EIT) with the packet identifier (PID) of P37 is overwritten to the unnecessary packet area TSoo with the packet identifier (PID) of P24. It should be

noted here that P32 (= P2), P10, P37 (= P7) in the second transport stream TS_2 are overwritten without changing the order thereof.

[0136]

(Step 27)

A new one custom transport stream (CTS) updated and buffered after being overwritten in the transport stream packet overwriting section 205 as mentioned above is sequentially outputted to the transport stream separating section 104.

[0137]

(Step 28)

The packet identifiers (PID) of the entitlement control message (ECM), the video signal and the audio signal for the image-recording-desired program are acquired from the program map table (PMT) in the second transport stream TS_2 including the image-recording-request program during currently receiving. This acquisition is performed in the transport stream separating section 104.

[0138]

(Step 29)

The packet identifiers (PID) of the entitlement control message (ECM), the video signal and the audio signal acquired in step 28 are registered in the second necessary packet identifier table 204_2. In Fig. 16, as an example, it is assumed that the packet identifier (PID) of the entitlement control message (ECM) is P11, the packet identifier (PID) of the video signal P12, and the packet identifier (PID) of the audio signal P13. Herewith, P2, P7, P10, P11, P12, P13 which are the packet identifiers (PID) of the program association table (PAT), the event information table (EIT), the program map table (PMT), the entitlement control message (ECM), the video signal and the

audio signal respectively for the image-recording-request program are registered in the second necessary packet identifier table 204_2.

[0139]

It should be noted here that P4 and P11 that are the packet identifiers (PID) of the entitlement control message (ECM) are different generally with regard to the broadcast program during viewing and the image-recording-requesy program, P5 and P12 that are the packet identifiers (PID) of the video signal are different generally, and P6 and P13 that are the packet identifiers (PID) of the audio signal are different generally, however, each pair of the packet identifiers may happen to be identical with each other.

[0140]

(Step 30)

The second transport stream packet extracting section 203_2 to which the second transport stream TS_2 is inputted extracts the transport stream packets having the packet identifiers (PID) registered in the second necessary packet identifier table 204_2, i.e. in the present case, the transport stream packets having the packet identifiers (PID) of the program association table (PAT), the event information table (EIT), the program map table (PMT), the entitlement control message (ECM), the video signal and the audio signal, from the second transport stream TS_2, and outputs them to the identical packet identifier determining section 303 and the packet identifier converting section 304 as necessary packet NecesP. In Fig. 16, the packets with the packet identifiers (PID) of P2, P10, P11, P12, P13, P7 are extracted.

[0141]

(Step 31)

The identical packet identifier determining section

303 determines whether P2, P10, P11, P12, P13, P7 that are the packet identifiers (PID) of the necessary packets NecesP inputted from the second transport stream packet extracting section 203_2 are the packet identifiers (PID) registered in the existing packet identifier table 302. If so, the process proceeds to step 32, otherwise to step 33. Here, in the case of P2 and P7, the process proceeds to step 32, and in the case of P10 to P13, the process skips to step 33.

[0142]

(Step 32)

When it is determined that the packet identifier (PID) extracted by the second transport stream packet extracting section 203_2 overlaps with the packet identifier (PID) in the first transport stream TS_1 in judgment of step 31, the process proceeds to step 32, in which the packet identifier converting section 304 converts the extracted packet identifiers (PID) of P2 and P7 into other packet identifiers (PID) distinguishable from each other and not registered in the existing packet identifier table 302. In Fig. 16, as an example, it is assumed that P2 is converted into P32 as in the preceding case, and P7 is done into P37 as in the preceding case.

[0143]

If P10 is identical with P3, P10 is also subject to packet identifier conversion. In a similar fashion, when P11 is identical with P4, P12 with P5 and P13 with P6 respectively, then the packet identifiers are subject to packet identifier conversion.

[0144]

(Step 33)

Then, the necessary packets NecesP of the program association table (PAT) and the event information table

(EIT) involving the packet identifiers (PID) of P32, P37 after the conversion, and the necessary packets NecesP of the program map table (PMT), the entitlement control message (ECM), the video signal and the audio signal involving the packet identifiers (PID) P10 to P13 that are not subject to packet identifier conversion are sent out to the transport stream packet overwriting section 205.

[0145]

(Step 34)

The unnecessary packet detector section 202 compares the inputted first transport stream TS_1 with the first necessary packet identifier table 201 for viewing, and detects the transport stream packet having the packet identifier (PID) not registered in the first necessary packet identifier table 201 for viewing in the first transport stream TS_1. The unnecessary packet detection information Unneces that is the detection result is supplied to the transport stream packet overwriting section 205.

[0146]

In Fig. 16, the unnecessary packet area TSoo where the packet identifiers (PID) in the first transport stream TS_1 are P20, P22, P24, P26, P28, P29, is not associated with any of the packet identifiers (PID) P1 to P7 registered in the first necessary packet identifier table 201 for viewing, and the unnecessary packet detector section 202 generates the unnecessary packet detection information Unneces for the unnecessary packet area TSoo with the packet identifiers (PID) of P20, P22, P24, P26, P28, P29 and outputs it to the transport stream packet overwriting section 205.

[0147]

(Step 35)

The transport stream packet overwriting section 205 receives supply of the first transport stream TS_1 from the demodulator section 102_1 and the unnecessary packet detection information Unneces from the unnecessary packet detector section 202, further, the transport stream packet overwriting section 205 receives supply of the necessary packets NecesP extracted by the second transport stream packet extracting section 203_2 and subject to packet identifier conversion by the packet identifier converting section 304 and the necessary packets NecesP not subject to packet identifier conversion so as to buffer them. The transport stream packet overwriting section 205 overwrites the necessary packets NecesP extracted from the second transport stream TS_2 to the unnecessary packet area TSoo in the first transport stream TS_1 indicated by the unnecessary packet detection information Unneces, and further buffers the new one transport stream generated by the overwriting.

[0148]

In Fig. 16, the transport stream packet of the program association table (PAT) with the packet identifier (PID) of P32 that is the necessary packet NecesP extracted from the second transport stream TS_2 is overwritten to the unnecessary packet area TSoo with the packet identifier (PID) P20 in the first transport stream TS_1. Also, the transport stream packet of the program map table (PMT) with the packet identifier (PID) of P10 is similarly overwritten to the unnecessary packet area TSoo with the packet identifier (PID) of P22. Similarly, the transport stream packet of the entitlement control message (ECM) with the packet identifier (PID) of P11 is overwritten to the unnecessary packet area TSoo with the packet identifier (PID) of P24. The transport stream packet of the video signal with the packet identifier (PID) of P12 is similarly

overwritten to the unnecessary packet area TSoo with the packet identifier (PID) of P26. The transport stream packet of the audio signal with the packet identifier (PID) of P13 is similarly overwritten to the unnecessary packet area TSoo with the packet identifier (PID) of P28. Further, the transport stream packet of the event information table (EIT) with the packet identifier (PID) of P37 is similarly overwritten to the unnecessary packet area TSoo with the packet identifier (PID) of P29. It should be noted here that the overwriting must be performed without changing the order of P32 (= P2), P10, P11, P12, P13, P37 (= P7) in the second transport stream TS_2.

[0149]

(Step 36)

As described above, a new one custom transport stream (CTS) updated and buffered by being overwritten in the transport stream packet overwriting section 205 is sequentially outputted to the transport stream separating section 104.

[0150]

As a result of the aforementioned sequential operation, the custom transport stream (CTS) includes the video signal, the audio signal and the data signal for the image-recording-request program in addition to the video signal, the audio signal and the data signal for the broadcast program during viewing.

[0151]

The operation of the transport stream separating section 104 and the image decoder 105, the image synthesizer 106, the audio decoder 107 and the digital interface 108 at the subsequent stage of the transport stream separating section 104 is similar to those of the prior art. Specifically, the transport stream separating

section 104 separates the transport stream (TS) of the video signal for the program designated by the user, and outputs it as an image stream to the image decoder 105, while separating the transport stream (TS) of the audio signal for the same program and outputting it to the audio decoder 107 as an audio stream. The image decoder 105 generates the image information through expanding and decoding a video stream, sends it out to the image synthesizer 106. The image synthesizer 106 converts the image information into analog form and generates the image signal, and outputs it to the monitor 801. Also, the audio decoder 107 expands and decodes the audio stream so as to generate an audio signal by thus converting it into analog form, and outputs it to the speaker 802. Also, the transport stream separating section 104 sends out the transport information for the image-recording-request program to the digital interface 108, and records the transport information in the digital recording device 803 through the digital interface 108. Namely, while continuing the broadcast program during viewing, the image-recording is made possible.

[0152]

Furthermore, in the foregoing description of the operation, illustration has been given of an example where the packet identifier is converted when the packet identifier (PID) of the necessary packet NecesP after extraction is identical with the packet identifier (PID) in the first transport stream TS_1 deals with the multiplexing of the data on the broadcast program during viewing and the data on the image-recording-request program, in the case of the multiplexing of the data on the broadcast program during viewing and the data on the image-recording-request program. In addition to this, as in the first embodiment,

any of the data of the broadcast program being viewed, the image-recording-desired program data, the broadcast program layout information (SI), the downloadable data and the data broadcast program data can also be multiplexed in an arbitrary combination. Further, it is not limited to only a combination of two, but a combination of three or more transport streams (TS) may be multiplexed.

[0153]

(Embodiment 3)

A third embodiment is configured so that NULL packets among unnecessary packets on overwritten-side transport streams are given priority, and overwriting is performed on the NULL packets, when arbitrary broadcast programs in a plurality of transport streams are multiplexed by overwriting. As example of operation, multiplexing between a broadcast program during viewing and download data will be taken up.

[0154]

Fig. 1 is common as a basic configuration also in the digital broadcast receiving apparatus according to the third embodiment. And, Fig. 17 is a block diagram showing a specific configuration of the multiplexer section according to the third embodiment.

[0155]

In Fig. 17, numeral 401 designates a NULL packet counter (empty packet counting means) for counting NULL packets included in a first transport stream TS_1, numerals 402_2 to 402_n designates second to n-th transport stream packet counters for counting necessary packets NecesP extracted by the second to n-th transport stream packet extracting sections 203_2 to 203_n respectively in the preceding stages, numeral 403 designates a comparing section (comparing means) for comparing a count value C_{NULL}

of the NULL packet counter 401 with a count value C_{NP} of any of the second to n-th transport stream packet counters 402_2 to 402_n and outputting comparison result signals corresponding to the cases of $C_{NULL} \geq C_{NP}$ and $C_{NULL} < C_{NP}$, and numeral 404 designates a NULL-packet-priority specifying section (empty packet priority specifying means) for preferentially specifying a NULL packet area as an unnecessary packet area to be an overwriting target to the transport stream packet overwriting section 205 in the case where the comparison result signal from the comparing section 403 indicates $C_{NULL} \geq C_{NP}$. Other component parts of the configuration are similar to those of the first embodiment (Fig. 1). Therefore, the same component elements are given the same reference numerals respectively, and not described again.

[0156]

Next, the operation of the digital broadcast receiving apparatus according to the third embodiment configured as described above is described with reference to the operation diagram of Fig. 18. In this case, as an example of operation to be described, it is assumed that the number of transport streams (TS) in CS digital broadcasting to be fetched in is two. Also, it is assumed that a first transport stream TS_1 is the one including a broadcast program being viewed, and a second transport stream TS_2 is the one including downloadable data. Specifically, the operation is described with reference to a case in which screen-viewing of the broadcast program during viewing and downloading of the downloadable data are realized at the same time when the broadcast program being viewed and the downloadable data are transmitted through different transport streams.

[0157]

(Step 1)

Once the user sets a viewing-request program in the input section 112, the CPU 109, the packet identifiers (PID) of transport stream packets including the video signal, the audio signal and the data signal, i.e. the elementary stream (ES) signal making up the broadcast program during viewing, and packet identifiers (PID) of transport stream packets including the program specification information (PSI) and the broadcast program layout information (SI) for the broadcast program during viewing are registered in the first necessary packet identifier table 201 for viewing corresponding to the first transport stream TS_1 based on the user setting information set in the input section 112.

[0158]

There are a network information table (NIT), a program association table (PAT), the program map table (PMT) and an entitlement control message (ECM) as a program specification information (PSI), while there are an event information table (EIT) required to present a name, time/date and contents of a program and other program information as the broadcast program layout information (SI). As a result, packet identifiers (PID) P1 to P7 are registered, as shown in Fig. 18, in the first necessary packet identifier table 201 for viewing, wherein P1 is the packet identifier (PID) of the network information table (NIT), P2 is the packet identifier (PID) of the program association table (PAT), P3 is the packet identifier (PID) of the program map table (PMT), P4 is the packet identifier (PID) of the entitlement control message (ECM), P5 is the packet identifier (PID) of the video signal for the broadcast program during viewing, P6 is the packet identifier (PID) of the audio signal for the broadcast

program during viewing, and P7 is the packet identifier (PID) of the event information table (EIT).

[0159]

(Step 2)

The user performs an operation to select downloading in the input section 112.

[0160]

(Step 3)

The CPU 109 switches to the transponder to which the desired downloadable data is transmitted. Specifically, by analyzing the network information table (NIT) acquired from the first transport stream TS_1 for the broadcast program during viewing, a download control table (DCT) where download control information is described is searched to detect the identifier (transport stream id) of the transport stream (TS) including the downloadable data. Then, transmission path information corresponding to the transport stream identifier (tsi) is acquired and set in the second tuner 101_2, while activating the second demodulator section 102_2. The modulated waves of the channel selected by this second tuner 101_2 is demodulated into a transport stream (TS) based on MPEG2 by the second demodulator section 102_2 and outputted to the second transport stream packet extracting section 203_2. This is the second transport stream TS_2 including the downloadable data.

[0161]

Moreover, the transport stream (TS) including the downloadable data may be received with another tuner.

[0162]

(Step 4)

The CPU 109 registers the packet identifier (PID) of the download control table (DCT), namely, P40 (the packet

identifier (PID)of which is "0x0017") where device types as download target and the like is described, in the second necessary packet identifier table 204_2 for the second tuner 101_2.

[0163]

(Step 5)

The second transport stream packet extracting section 203_2 to which the second transport stream TS_2 is inputted, extracts the transport stream packet having the packet identifier (PID) registered in the second necessary packet identifier table 204_2, i.e. in the present case, P40 that is the packet identifier (PID) of the download control table (DCT) from the second transport stream TS_2, and outputted to the transport stream packet overwriting section 205 as a necessary packet NecesP.

[0164]

(Step 6)

The respective packet identifiers (PID), namely, P41, P42 with respect to a download table where download program is described (DLT, the packet identifier (PID) of which is described in the download control table (DCT)) and the entitlement control message (ECM) (the packet identifier (PID) of which is described in the download control table (DCT)) required for descrambling the download table (DLT), are acquired from the download control table (DCT) in the second transport stream TS_2 including the downloadable data during currently received.

[0165]

(Step 7)

The packet identifiers (PID) P41 and P42 of the download table (DLT) and the entitlement control message (ECM) acquired in step 6 are registered in the second necessary packet identifier table 204_2. Herewith, the

packet identifiers (PID) P40, P41 and P42 of the download control table (DCT), the download table (DLT) and the entitlement control message (ECM) for the downloadable data are registered in the second necessary packet identifier table 204_2.

[0166]

(Step 8)

The second transport stream packet extracting section 203_2 to which the second transport stream TS_2 is inputted extracts the transport stream packet having the packet identifiers (PID) registered in the second necessary packet identifier table 204_2, i.e. in the present case, the packet identifiers (PID) of the download control table (DCT), the download table (DLT) and the entitlement control message (ECM) from the second transport stream TS_2, and outputted to the second transport stream packet counter 402_2 and the transport stream packet overwriting section 205, as necessary packets NecesP.

[0167]

In Fig. 18, only the necessary packets NecesP where the packet identifiers (PID) are P40, P41 and P42, i.e. only the packets of the download control table (DCT), the download table (LT) and the entitlement control message (ECM) are extracted.

[0168]

(Step 9)

The NULL packet counter 401 counts the NULL packets included in the first transport stream TS_1 in a certain time interval T_0 and the resulting count value C_{NULL} is outputted to the comparing section 403.

[0169]

(Step 10)

The second transport stream packet counter 402_2

counts the necessary packets NecesP extracted in step 8 at the aforementioned time interval T_0, and the resulting count value C_{NP} is outputted to the comparing section 403.

[0170]

(Step 11)

The comparing section 403 compares the count value C_{NULL} from the NULL packet counter 401 with the count value C_{NP} from the second transport stream packet counter 402_2, and in the case where it is $C_{NULL} \geq C_{NP}$, the process proceeds to step 12, while in the case where it is $C_{NULL} < C_{NP}$, the process proceeds to step 13.

[0171]

(Step 12)

In the case where it is $C_{NULL} \geq C_{NP}$, the process proceeds to this step 12, wherein the transport stream overwriting section 205 sequentially overwrites the necessary packets NecesP from the second transport stream packet extracting section 203_2 in order of detection to the NULL packets in the first transport stream TS_1. In this case, the overwriting operation is performed in such a manner that the necessary packets NecesP overwritten are distributed substantially equally in number in the former and latter halves of the aforementioned time interval T_0. This corresponds to the case shown in Fig. 18(a).

[0172]

(Step 13)

In the case where it is $C_{NULL} < C_{NP}$, the process proceeds to this step 13, wherein the transport stream overwriting section 205 performs overwriting operation in such a manner that the necessary packets NecesP overwritten are distributed substantially equally in number in the former and latter halves of the aforementioned time interval T_0 and that while giving priority to the NULL

packets, the necessary packets NecesP are overwritten to the unnecessary packets on the first transport stream TS_1 based on the unnecessary packet detection information Unneces from the unnecessary packet detector section 202 in the case where the NULL packets are in short supply. This corresponds to the case of Fig. 18(b).

[0173]

(Step 14)

A new one custom transport stream (CTS) updated and buffered by being overwritten in the transport stream packet overwriting section 205 according to the way described above is sequentially outputted to the transport stream separating section 104.

[0174]

As a result of the aforementioned sequential operation, the custom transport stream (CTS) includes the downloadable data in addition to the video signal, the audio signal and the data signal for the broadcast program during viewing.

[0175]

The downloadable data is transferred to and stored in a nonvolatile memory or a hard disk constituting the digital recording device 803 from the transport stream separating section 104 through the digital interface 108.

[0176]

According to the manner described above, the broadcast program during viewing is continued while data such as a new program can be downloaded at the same time.

[0177]

(Embodiment 4)

And now, as a modified embodiment of the third embodiment, the configuration described below is also conceivable. This corresponds to the configuration of Fig.

17 omitting the NULL packet counter 401. In the absence of the NULL packet counter 401, it is not known whether or not the number of the NULL packets in the first transport stream TS_1 runs short in comparison with the number of the necessary packets NecesP after extraction at a certain time interval T_0.

[0178]

In view of this, the transport stream packet overwriting section 205, on the assumption that the NULL packets in the first transport stream TS_1 are given priority as packet areas for overwriting the necessary packets NecesP, operates in such a manner that whenever even at least one necessary packet NecesP is inputted, the overwriting operation is performed as soon as a NULL packet of the first transport stream TS_1 is inputted, while as long as no NULL packet arrives, the input of a next NULL packet is awaited. As soon as the next NULL packet is inputted, the necessary packet NecesP in the gradually standby state is overwritten on the NULL packet.

[0179]

When input of the NULL packet is delayed, however, the number of the necessary packets NecesP in the standby state gradually increases. The transport stream packet overwriting section 205, therefore, once the number of the necessary packets NecesP in the standby state reaches a certain value, the waiting for the input of the NULL packet is interrupted, and the packets are overwritten to the unnecessary packet area other than the NULL packets in the first transport stream TS_1.

[0180]

The operation state of the fourth embodiment is shown in Figs. 19(a), (b). Fig. 19(a) shows a case involving comparatively large number of NULL packets, in which all

the necessary packets NecesP extracted are overwritten on the NULL packets. Fig. 19(b) shows a case involving comparatively small number of NULL packets, wherein the packets are also overwritten to the unnecessary packet area TSoo other than the NULL packets in the last half of the time interval T_0.

[0181]

In addition, in the foregoing description of operation of the third and fourth embodiments, shown is a case wherein the NULL packets are given priority among the unnecessary packets in the first transport stream TS_1 as packet areas for overwriting the necessary packets NecesP after extraction in multiplexing between the data for the broadcast program during viewing and the downloadable data. However, as in the first embodiment, the multiplexing is also possible in an arbitrary combination of the program data during viewing, the image-recording-request program data, the broadcast program layout information (SI), the downloadable data, the data broadcast program data, and the like. Further, the multiplexing may be carried out in not only a combination of two input transport streams (TS) but also a combination of three or more transport streams (TS).

[0182]

(Embodiment 5)

A fifth embodiment is configured so that arbitrary programs (contents) in a plurality of transport streams (TS) in digital broadcasting are multiplexed not by overwriting but by "insertion". As an example of operation, multiplexing of a broadcast program during viewing and a data broadcast program such as an electronic music delivery (EMD) are taken up.

[0183]

Fig. 1 is common as a basic configuration of the

digital broadcast receiving apparatus according to the fifth embodiment. Fig. 20 is a block diagram showing a specific configuration of a multiplexer section according to the fifth embodiment.

[0184]

In Fig. 20, numeral 203_1 designates a first transport stream packet extracting section for extracting necessary transport stream packets from a first transport stream TS_1 outputted from the first demodulator section 102_1, and numeral 204_1 designates a first necessary packet identifier table for registering packet identifiers (PID) required for packet extraction by the first transport stream packet extracting section 203_1, which corresponds to the first necessary packet identifier table 201 for viewing according to the first to third embodiments described above. The first transport stream packet extracting section 203_1 is similar to the other second to n-th transport stream packet extracting sections 203_2 to 203_n, while the first necessary packet identifier table 204_1 is similar to the other second to n-th necessary packet identifier tables 204_2 to 204_n. Numeral 501 designates a transport stream packet inserting section. Other parts of the configuration are similar to those of the first embodiment (Fig. 1), and therefore, the same component elements are given the same reference numerals respectively and not described again.

[0185]

Next, the operation of the digital broadcast receiving apparatus according to the fifth embodiment configured as described above is described with reference to the operation diagrams of Figs 21 to 23. In this case, it is assumed that the number of transport streams (TS) to be fetched in is two. Also, it is assumed that the first transport stream TS_1 is the one including the broadcast

program during viewing, and the second transport stream the one including the data broadcast program. Specifically, the operation in simultaneously realizing screen-viewing of the broadcast program during viewing and receiving of the data broadcast program is described when the broadcast program during viewing and the data broadcast program such as electronic music delivery (EMD) are transmitted in different transport streams.

[0186]

(Step 1)

Once the user sets a viewing-request program in the input section 112, the CPU 109 registers the packet identifiers (PID) of the transport stream packet including the video signal, the audio signal and the data signal making up the broadcast program being viewed, i.e. the elementary stream (ES) signal, and the packet identifiers (PID) of the transport stream packet including the program specification information (PSI) and the broadcast program layout information (SI) for the broadcast program being viewed are registered in the first necessary packet identifier table 204_1 corresponding to the first transport stream TS_1, based on the user setting information set by way of the input section 112.

[0187]

There are a network information table (NIT), a program association table (PAT), a program map table (PMT) and an entitlement control message (ECM) as the program specification information (PSI), while there are an event information table (EIT) required for presentation of a program information such as a name, time/date and contents of the program as the broadcast program layout information (SI). As a result, the packet identifiers (PID) P1 to P7, wherein P1 is the packet identifier (PID) of the network

information table (NIT), P2 is the packet identifier (PID) of the program association table (PAT), P3 is the packet identifier (PID) of the program map table (PMT), P4 is the packet identifier (PID) of the entitlement control message (ECM), P5 is the packet identifier (PID) of the video signal for the broadcast program during viewing, P6 is the packet identifier (PID) of the audio signal for the broadcast program during viewing and P7 is the packet identifier (PID) of the event information table (EIT), are registered in the first necessary packet identifier table 201 for viewing, as shown in Fig. 21.

[0188]

(Step 2)

The user performs an operation for selecting a data broadcast program in the input section 112.

[0189]

(Step 3)

The CPU 109 switches to the transponder to which the desired data broadcast program is transmitted. Specifically, by analyzing the network information table (NIT) acquired from the first transport stream TS_1 for the broadcast program during viewing, the identifier (transport stream id) of the transport stream under transmitting the data broadcast program is detected, and the transmission path information corresponding to the transport stream identifier (tsi) is acquired and set in the second tuner 101_2 while activating the second demodulator section 102_2. The modulated wave of the channel selected by this second tuner 101_2 is demodulated into a transport stream (TS) according to MPEG2 by the demodulator section 102_2 and outputted to the second transport stream packet extracting section 203_2. This is the second transport stream TS_2 including the data broadcast program.

[0190]

Farther, the transport stream (TS) including the data broadcast program may be received with another tuner.

[0191]

(Step 4)

The CPU 109 operates in such a manner that the packet identifier (PID) of a high-order program association table (PAT) in the program specification information (PSI) of the data broadcast program, i.e. P2 and the packet identifier (PID) of the event information table (EIT) that is the broadcast program layout information (SI), i.e. P7 are registered in the second necessary packet identifier table 204_2 for the second tuner 101_2.

[0192]

(Step 5)

The first transport stream packet extracting section 203_1 to which the first transport stream TS_1 is inputted extracts the transport stream packet having the packet identifier (PID) registered in the first necessary packet identifier table 204_1, i.e. here, each packet identifier (PID) of NIT, PAT, PMT, ECM, video signal, audio signal and EIT from the first transport stream TS_1, and outputted it to the transport stream packet inserting section 501 as a necessary packet $NecesP_1$.

[0193]

In Fig. 21, only the necessary packets $NecesP_1$ with the packet identifiers (PID) P1, P2, P3, P4, P5, P6, P7, i.e. only the packets of NIT, PAT, PMT, ECM, video signal, audio signal and EIT are extracted.

[0194]

Similarly, the second transport stream packet extracting section 203_2 to which the second transport stream TS_2 is inputted extracts the transport stream

packets having the packet identifiers (PID) registered in the second necessary packet identifier table 204_2, i.e. in the present case, the packet identifiers (PID) of the program association table (PAT) and the event information table (EIT) from the second transport stream TS_2, and outputted it to the transport stream packet inserting section 501 as necessary packets $NecesP_2$.

[0195]

In Fig. 21, only the necessary packets $NecesP_2$ with P2 and P7 as the packet identifiers (PID), i.e. only the packets of the program association table (PAT) and the event information table (EIT) are extracted.

[0196]

(Step 6)

The transport stream packet inserting section 501 receives supply individually of the necessary packets $NecesP_1$ extracted by the first transport stream packet extracting section 203_1 and the necessary packets $NecesP_2$ extracted by the second transport stream packet extracting section 203_2 and buffers them. Both the necessary packets $NecesP_1$, $NecesP_2$ thus extracted are multiplexed by insertion into each other in a predetermined order, and a new one transport stream generated through multiplexing by the insertion is further buffered. In this case, the order among the necessary packets $NecesP_1$ in the first transport stream TS_1 is identical with the order among those in the original first transport stream TS_1. Similarly, the order among the necessary packets $NecesP_2$ in the second transport stream TS_2 is identical with the order among those in the original second transport stream TS_2. And, the sequential order is kept unchanged. Also, in the absence of the extracted necessary packet at a predetermined timing, NULL packets are inserted.

[0197]

(Step 7)

A new one custom transport stream (CTS) updated and buffered through being inserted by the transport stream packet inserting section 501 according to the way described above is sequentially outputted to the transport stream separating section 104.

[0198]

(Step 8)

From the program association table (PAT) in the second transport stream TS_2 including the data broadcast program received currently, the packet identifier (PID) of the program map table (PMT) for the data broadcast program is acquired. This acquisition is performed with the transport stream separating section 104.

[0199]

(Step 9)

The packet identifier (PID) of the program map table (PMT) acquired in step 8 is registered in the second necessary packet identifier table 204_2. In this case, as an example, it is assumed that the packet identifier (PID) of the program map table (PMT) is P51. Herewith, P2, P7 and P51, which are the packet identifiers (PID) of the program association table (PAT), the event information table (EIT) and the program map table (PMT) for the data broadcast program, are registered in the second necessary packet identifier table 204_2.

[0200]

(Step 10)

The first transport stream packet extracting section 203_1, as in step 5, extracts the packet identifiers (PID) registered in the first necessary packet identifier table 204_1, i.e. the transport stream packets of NIT, PAT, PMT,

ECM, video signal, audio signal and EIT having P1, P2, P3, P4, P5, P6, P7 respectively from the first transport stream TS_1, and outputted them to the transport stream packet inserting section 501 as necessary packets $NecesP_1$.

[0201]

Similarly, the second transport stream packet extracting section 203_2 extracts the packet identifiers (PID) registered in the second necessary packet identifier table 204_2, i.e. here, the transport stream packets having the packet identifiers (PID) of the program association table (PAT), the event information table (EIT) and the program map table (PMT) from the second transport stream TS_2, and outputted them to the transport stream packet inserting section 501 as necessary packets $NecesP_2$.

[0202]

In Fig. 22, only the necessary packets $NecesP_2$ having the packet identifiers (PID) of P2, P7 and P51, i.e. only the packets of the program association table (PAT), the event information table (EIT) and the program map table (PMT) are extracted.

[0203]

(Step 11)

In the transport stream packet inserting section 501, as in step 6, the necessary packets $NecesP_1$ extracted by the first transport stream packet extracting section 203_1 and the necessary packets $NecesP_2$ extracted by the second transport stream packet extracting section 203_2 are individually inputted so as to buffer them. Both the extracted necessary packets $NecesP_1$ and $NecesP_2$ are multiplexed by being inserted into each other in a predetermined order, and one new transport stream generated by the insertion and multiplexing is further buffered. In the absence of the extracted necessary packets at a

predetermined timing, NULL packets are inserted.

[0204]

(Step 12)

The new one custom transport stream (CTS) updated and buffered through being inserted by the transport stream packet inserting section 501 as described above is sequentially outputted to the transport stream separating section 104.

[0205]

(Step 13)

The packet identifier (PID) of the data for the data broadcast program is acquired from the program map table (PMT) in the second transport stream TS_2 including the data broadcast program received currently.

[0206]

(Step 14)

The packet identifier (PID) of the data for the data broadcast program acquired in step 13 is registered in the second necessary packet identifier table 204_2. In this case, as an example, the packet identifier (PID) of the data for the data broadcast program is assumed to be P52. Herewith, P2, P7, P51, P52, which are the packet identifiers (PID) of the program association table (PAT), the event information table (EIT), the program map table (PMT) for the data broadcast program and the data for the data broadcast program respectively, are registered in the second necessary packet identifier table 204_2.

[0207]

Thereto, in this case, it is assumed that the data broadcast program is in non-scrambled form, and multiplexing of the entitlement control message (ECM) is not carried out. In some cases, however, the ECM may be multiplexed.

[0208]

(Step 15)

The first transport stream packet extracting section 203_1, as in step 5, extracts the packet identifiers (PID) registered in the first necessary packet identifier table 204_1, namely, the transport stream packets of NIT, PAT, PMT, ECM, video signal, audio signal and EIT having P1, P2, P3, P4, P5, P6, P7 from the first transport stream TS_1, and outputted them to the transport stream packet inserting section 501 as necessary packets NecesP.

[0209]

Similarly, the second transport stream packet extracting section 203_2 extracts the packet identifiers (PID) registered in the second necessary packet identifier table 204_2, i.e., here, the transport stream packets having, the packet identifiers (PID) of the program association table (PAT), the event information table (EIT), the program map table (PMT) and the data for the data broadcast program, from the second transport stream TS_2, and outputted them to the transport stream packet inserting section 501 as necessary packets NecesP.

[0210]

In Fig. 23, only the necessary packets $NecesP_2$ having the packet identifiers (PID) of P2, P7, P51, P52, i.e. only the packets of the program association table (PAT), the event information table (EIT), the program map table (PMT) and the data for the data broadcast program are extracted.

[0211]

(Step 16)

The transport stream packet inserting section 501, as in step 6, receives supply of the necessary packet $NecesP_1$ extracted by the first transport stream packet extracting section 203_1 and the necessary packet $NecesP_2$ extracted by

the second transport stream packet extracting section 203_2 individually to buffer them. Both of the necessary packets $NecesP_1$ and $NecesP_2$ extracted are multiplexed through being inserted in a predetermined order, and new one transport stream generated by the multiplexing through insertion is further buffered. In the absence of the extracted necessary packets at a predetermined timing, NULL packets are inserted.

[0212]

(Step 17)

The new one custom transport stream (CTS) updated and buffered through being inserted by the transport stream packet inserting section 501 as described above is sequentially outputted to the transport stream separating section 104.

[0213]

According to the above sequential operation, the custom transport stream (CTS) includes the data signal for the data broadcast program in addition to the video signal, audio signal and data signal for the broadcast program being viewed.

[0214]

The data for the data broadcast program is sent out to, for example, an MD recorder as a digital recording device 803 through the digital interface 108 from the transport stream separating section 104. Then, it becomes possible to record music or to listen to the music while recording it. Specifically, while continuing the broadcast program during viewing, the data broadcast program such as an electronic music delivery (EMD) can be received and recorded.

[0215]

Furthermore, in the foregoing description of the

operation, exemplified is the case where only the necessary transport stream packets are extracted from both of the first transport stream TS_1 and the second transport stream TS_2, and the necessary packets $NecesP_1$, and $NecesP_2$ thus extracted are inserted into each other, in the multiplexing of the data for the broadcast program during viewing and the data for the data broadcast program. Alternatively, however, as in the first embodiment, packets can be multiplexed by insertion in an arbitrary combination of the program data during viewing, the image-recording-request program data, the broadcast program layout information (SI), the downloadable data and the data broadcast program data, and the like. Further, input transport streams (TS) may be multiplexed in a combination of not only two but also three or more transport streams (TS).

[0216]

(Embodiment 6)

In the foregoing description of the fifth embodiment, P2,that is the packet identifier (PID) of the program association table (PAT) in the first transport stream TS_1 and the second transport stream TS_2, is equal each other, and P7 that is the packet identifier (PID) of the event information table (EIT) is also identical each other, which are multiplexed with no distinction in the custom transport stream (CTS). To distinguish them from each other, the fifth embodiment may be configured to perform packet identifier conversion in a way similar to the second embodiment. This modified embodiment is an example where such countermeasure is devised, the block diagram is shown in Fig. 24. The operation is substantially the same as that described above, and is not described again.

[0217]

In addition, in the foregoing respective embodiments,

only the acquisition of an arbitrary combination of programs (contents) for a plurality of transport streams in the CS digital broadcasting is described, however it is not necessarily to be obsessed with the above example in the present invention, and it may be also applicable to the BS digital broadcasting and the digital terrestrial broadcasting other than the CS digital broadcasting as a target. Further, the present invention is applicable to an arbitrary combination of contents from a plurality of transport streams (TS) under mixture of the plurality of the broadcasting forms. Since the form of transport stream (TS) outputted from the demodulator section becomes MPEG that is common to the plurality of types of broadcasting forms described above, the common transport stream separating section need not particularly be changed. MPEG may be in any of phases 1, 2, 4, and 7. Also, JPEG is applicable.

[0218]

[Effects of the Invention]

In the digital broadcast receiving apparatus according to this invention, a common custom transport stream, that contains a plurality of necessary packets included in a plurality of originally different transport streams mutually in a converging state, is generated. Thus, a great variety of receiving forms of digital broadcasting can be realized. For example, regardless of whether or not transport stream includes information such as a program including video and audio data, a broadcast program table, downloadable data and data broadcast such as electronic music delivery, it is possible to realize a great variety of services such as screen-viewing, broadcast program table display, image-recording, downloading and data broadcast receiving in arbitrary combinations simultaneously.

[0219]

And, the necessary transport stream packet might be separated from the common custom transport stream in which a plurality of necessary packets having different origins is multiplexed. Thus, a common transport stream separating section can be used. Also, various decoders and digital interfaces at rear stages can be constructed to comply with a single system of transport stream, which leads to cost and size reduction.

[0220]

Further, compared with the prior art (for example, see Japanese Unexamined Patent Application Publication No. 11-122556) configured so that all the transport stream packets in a plurality of transport streams are multiplexed by time division into a frequency higher than the sum of the transmission bit rates of the transport streams so as to generate a single system of transport stream, such advantageous effects can be exerted that the cost can be further reduced while transport streams capable of handling at higher speed is made to be a target because the aforementioned means for generating a high frequency is not required.

[0221]

Also, in the case where the transport stream packets to be multiplexed (by overwriting or insertion) have the same packet identifier with each other, the packet identifier is rewritten and converted into different packet identifiers. By doing so, a plurality of packets having different origins in the common custom transport stream can be distinguished from one another, and each packet identifier of all the packets can be uniquely determined. Thus, desired packets can be retrieved securely and accurately.

[0222]

Also, an efficient multiplex operation can be realized by performing overwriting on empty packets in preference.

[Brief Description of the Drawings]

[Fig. 1] A block diagram shows a common electrical configuration of the digital broadcast receiving apparatuses according to the first to sixth embodiments of the present invention.

[Fig. 2] A block diagram shows a specific configuration of the multiplexer section in the digital broadcast receiving apparatus according to the first embodiment.

[Fig. 3] A flowchart illustrates the operation in the digital broadcast receiving apparatus according to the first embodiment.

[Fig. 4] A diagram illustrates the operation in the digital broadcast receiving apparatus according to the first embodiment.

[Fig. 5] A schematic diagram shows the state in which "screen-viewing and image-recording" are performed in combination with the digital broadcast receiving apparatus according to an embodiment of the present invention.

[Fig. 6] A schematic diagram shows the state in which "screen-viewing and downloading" are performed in combination with the digital broadcast receiving apparatus according to an embodiment of the present invention.

[Fig. 7] A schematic diagram shows the state in which "screen-viewing and data broadcast program receiving" are performed in combination with the digital broadcast receiving apparatus according to an embodiment of the present invention.

[Fig. 8] A schematic diagram shows the state in

which "one screen-viewing and another screen-viewing" are performed in combination with the digital broadcast receiving apparatus according to an embodiment of the present invention.

[Fig. 9] A block diagram shows a specific configuration of the multiplexer section of the digital broadcast receiving apparatus according to a second embodiment.

[Fig. 10] A flowchart explains the operation of the digital broadcast receiving apparatus according to the second embodiment.

[Fig. 11] A flowchart explains the operation of the digital broadcast receiving apparatus according to the second embodiment (continued from Fig. 10).

[Fig. 12] A flowchart explains the operation of the digital broadcast receiving apparatus according to the second embodiment (continued from Fig. 11).

[Fig. 13] A flowchart explains the operation of the digital broadcast receiving apparatus according to the second embodiment (continued from Fig. 12).

[Fig. 14] A diagram explains the operation of the digital broadcast receiving apparatus according to the second embodiment.

[Fig. 15] A diagram explains the operation of the digital broadcast receiving apparatus according to the second embodiment (continued from Fig. 9).

[Fig. 16] A diagram explains the operation of the digital broadcast receiving apparatus according to the second embodiment (continued from Fig. 10).

[Fig. 17] A block diagram shows a specific configuration of the multiplexer section of the digital broadcast receiving apparatus according to a third embodiment.

[Fig. 18] A diagram explains the operation of the digital broadcast receiving apparatus according to the third embodiment.

[Fig. 19] A diagram explains the operation of the digital broadcast receiving apparatus according to a fourth embodiment.

[Fig. 20] A block diagram shows a specific configuration of the multiplexer section of the digital broadcast receiving apparatus according to a fifth embodiment.

[Fig. 21] A diagram explains the operation of the digital broadcast receiving apparatus according to the fifth embodiment.

[Fig. 22] A diagram explains the operation of the digital broadcast receiving apparatus according to the fifth embodiment (continued from Fig. 16).

[Fig. 23] A diagram explains the operation of the digital broadcast receiving apparatus according to the fifth embodiment (continued from Fig. 17).

[Fig. 24] A block diagram shows a specific configuration of the multiplexer section of the digital broadcast receiving apparatus according to a sixth embodiment.

[Fig. 25] A block diagram shows an electrical configuration of a conventional digital broadcast receiving apparatus.

[Fig. 26] A diagram shows the configuration of the MPEG2 transport stream packet.

[Description of Reference Numerals]

101_i Tuner (i = 1, 2,...n, as hereinafter)

102_i Demodulator section

103 Multiplexer section

104 Transport stream separating section

105 Image decoder

106 Image synthesizer

107 Audio decoder

108 Digital interface

109 CPU

110 ROM

111 RAM

112 Input section

113 Bus

201 First necessary packet identifier table

202 Unnecessary packet detector section

203_1 First transport stream packet extracting section

203_j Transport stream packet extracting section (j = 2,...n, as hereinafter)

204_1 First necessary packet identifier table

204_j Necessary packet identifier table

205 Transport stream packet overwriting section

301 Packet identifier extracting section

302 Existing packet identifier table

303 Identical packet identifier determining section

304 Packet identifier converting section

401 NULL packet counter (empty packet counting means)

402_j Transport stream packet counter

403 Comparing section (comparing means)

404 NULL-packet-priority specifying section (empty packet-priority-specifying means)

501 Transport stream packet inserting section (packet inserting means)

801 Monitor

802 Speaker

803 Digital recording device

TS_1 First transport stream

TS_2 Second transport stream

CTS Custom transport stream

P1 Packet identifier (PID) of network information table (NIT)

P2 Packet identifier (PID) of program association table (PAT)

P3 Packet identifier (PID) of program map table (PMT)

P4 Packet identifier (PID) of entitlement control message (ECM)

P5 Packet identifier (PID) of video signal

P6 Packet identifier (PID) of audio signal

P7 Packet identifier (PID) of event information table (EIT)

NecesP Necessary packet

Unneces Unnecessary packet detection information

Tsoo Unnecessary packet area

[Document Name] ABSTRACT

[Abstract]

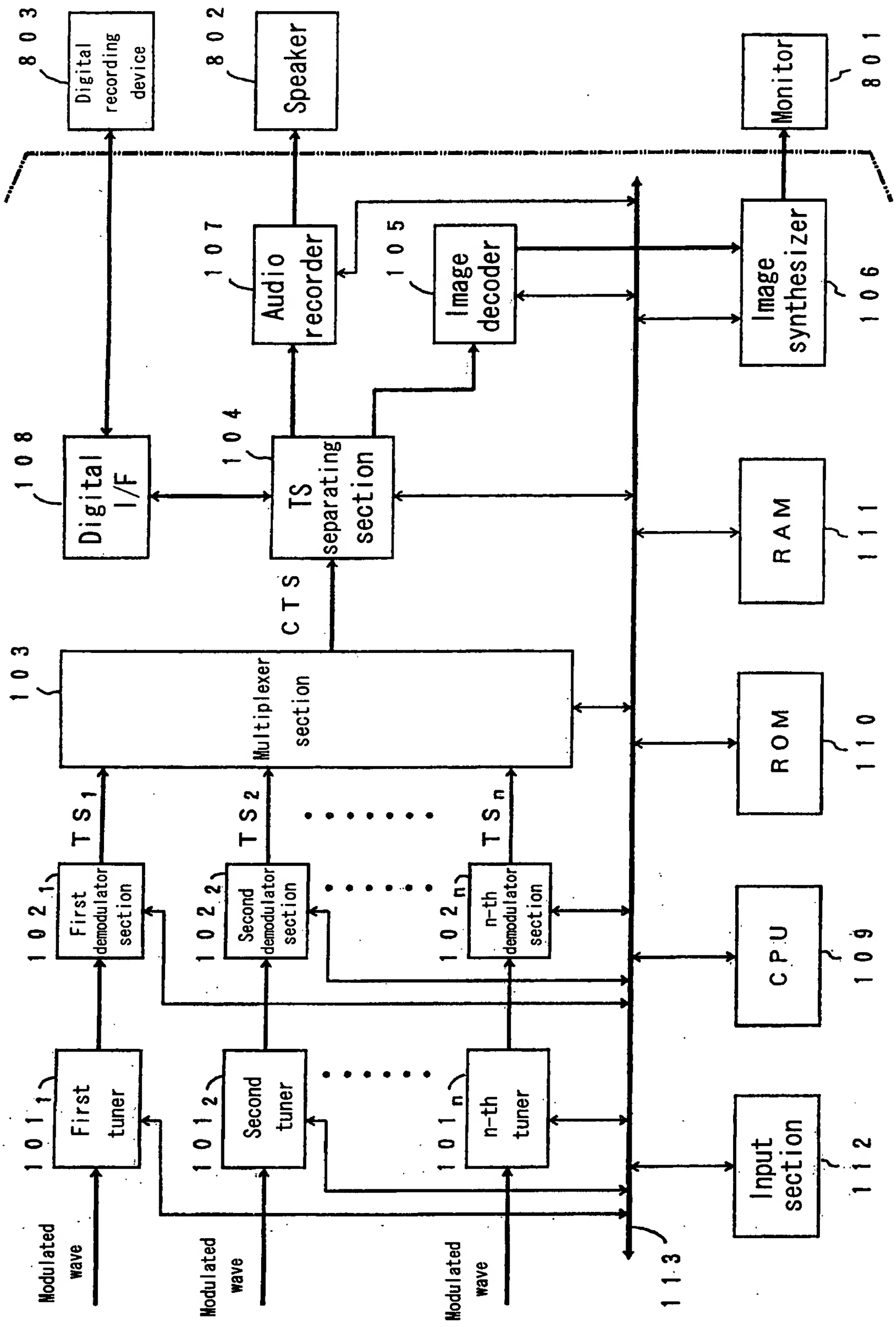
[Purpose] To realize a low-cost digital broadcast receiving apparatus in which arbitrary contents are received simultaneously from a plurality of transport streams (TS) without time-division multiplexing at a frequency higher than the sum of the transmission bit rates of the plurality of streams.

[Solution] Packet identifiers (PID) of necessary packets are registered in a necessary packet identifier table 201 and the packet identifiers of the necessary packets are registered in a necessary packet identifier table 204_2. A transport stream packet extracting section 203_2 extracts necessary packets NecesP from a second TS_2 based on the packet identifiers in the necessary packet identifier table 204_2. An unnecessary packet detector section 202 detects unnecessary packet areas TSoo in a first TS_1 based on the packet identifiers in the necessary packet identifier table 201. A transport stream packet overwriting section 205 multiplexes by overwriting the extracted necessary packets to the unnecessary packet areas TSoo.

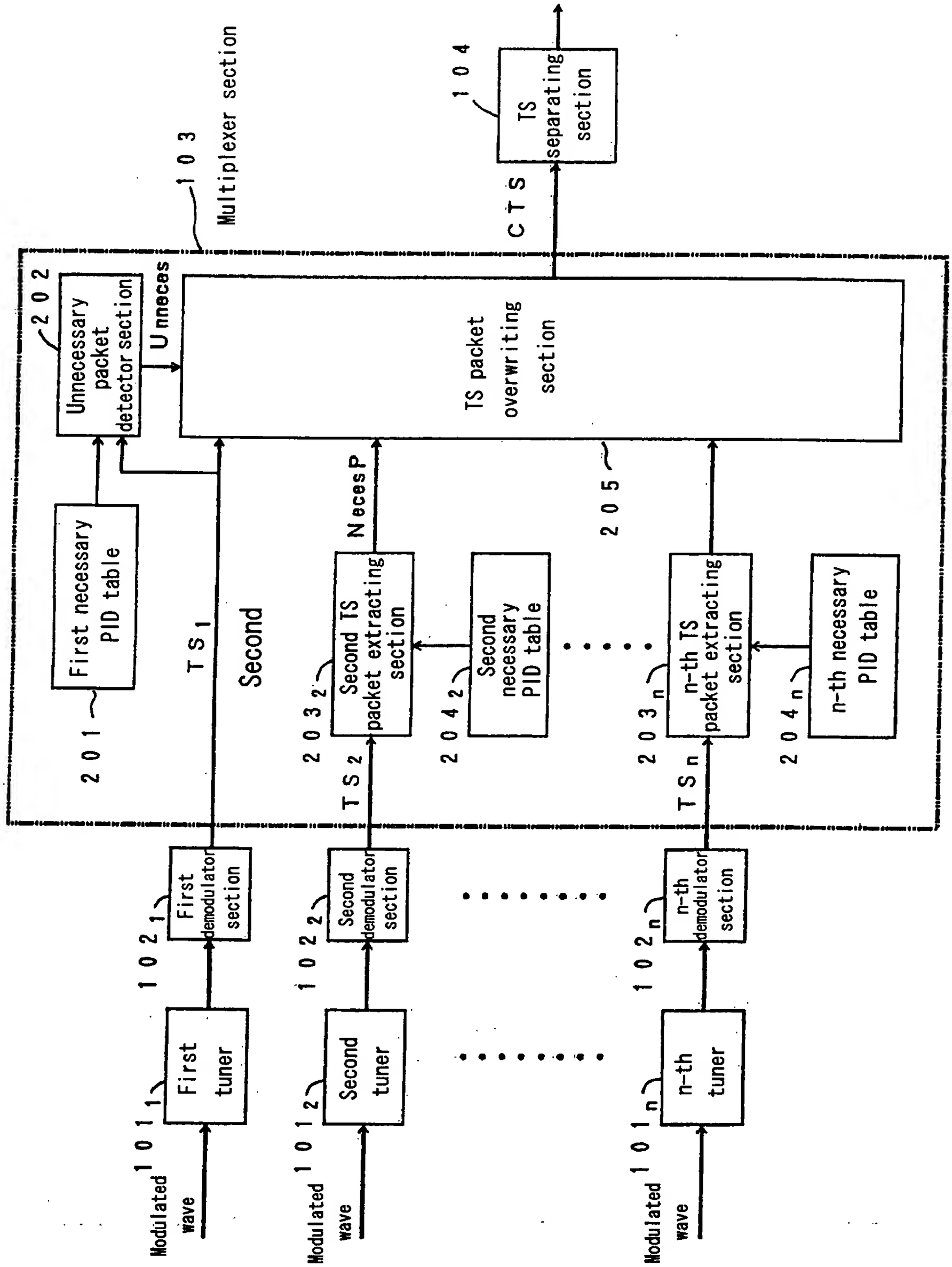
[Selected Drawing] Fig. 2

【Name of the Document】 Drawing

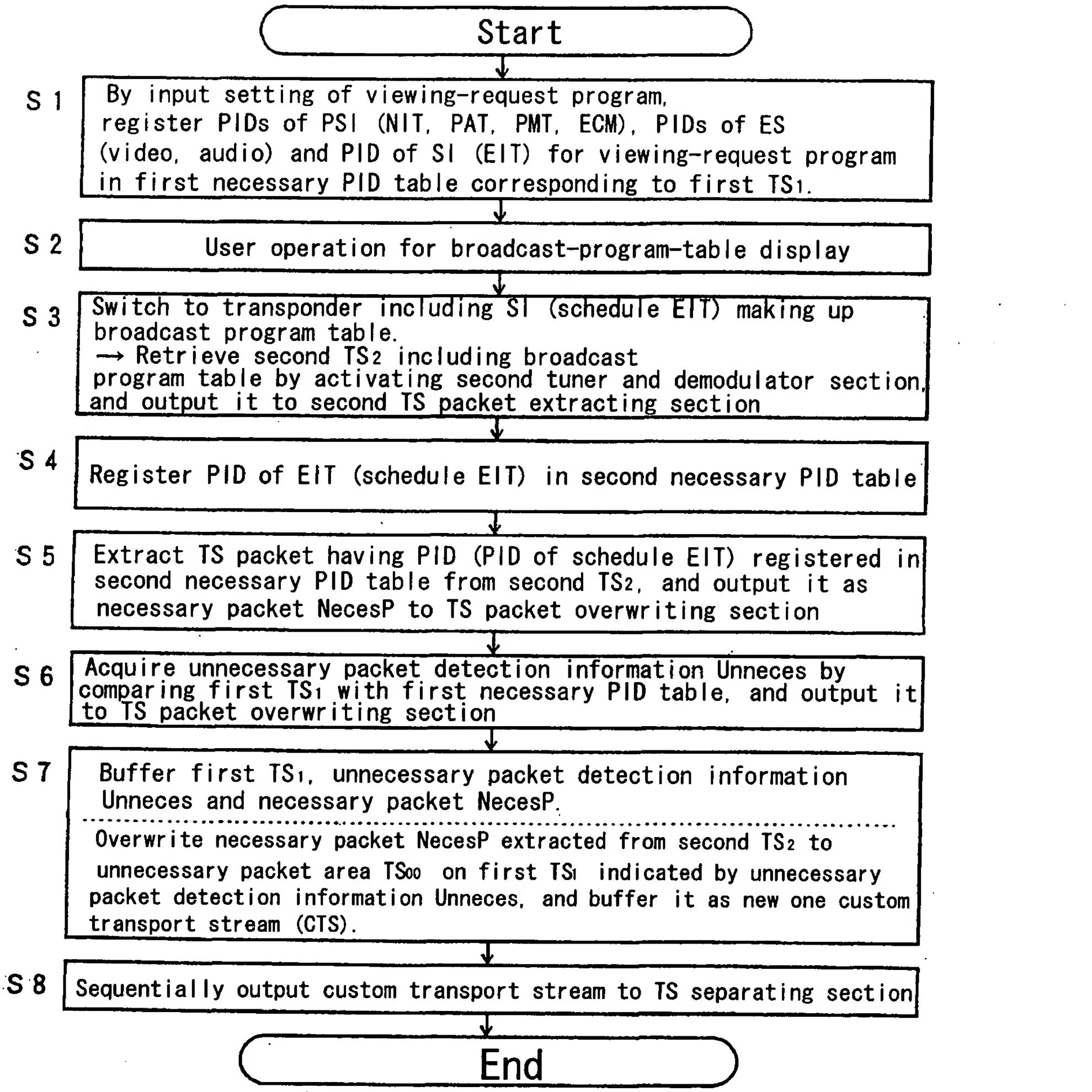
【FIG. 1】



【FIG. 2】


Modulated wave
First tuner
Second tuner
n-th tuner
First demodulator section
Second demodulator section
n-th demodulator section
First necessary PID table
Second necessary PID table
n-th necessary PID table
First packet extracting section
Second TS packet extracting section
n-th TS packet extracting section
TS packet overwriting section
Unnecessary packet detector section
Multiplexer section
TS separating section
CTS
Unnecessary packet
Necessary packet
TS1
TS2
TSn
Second

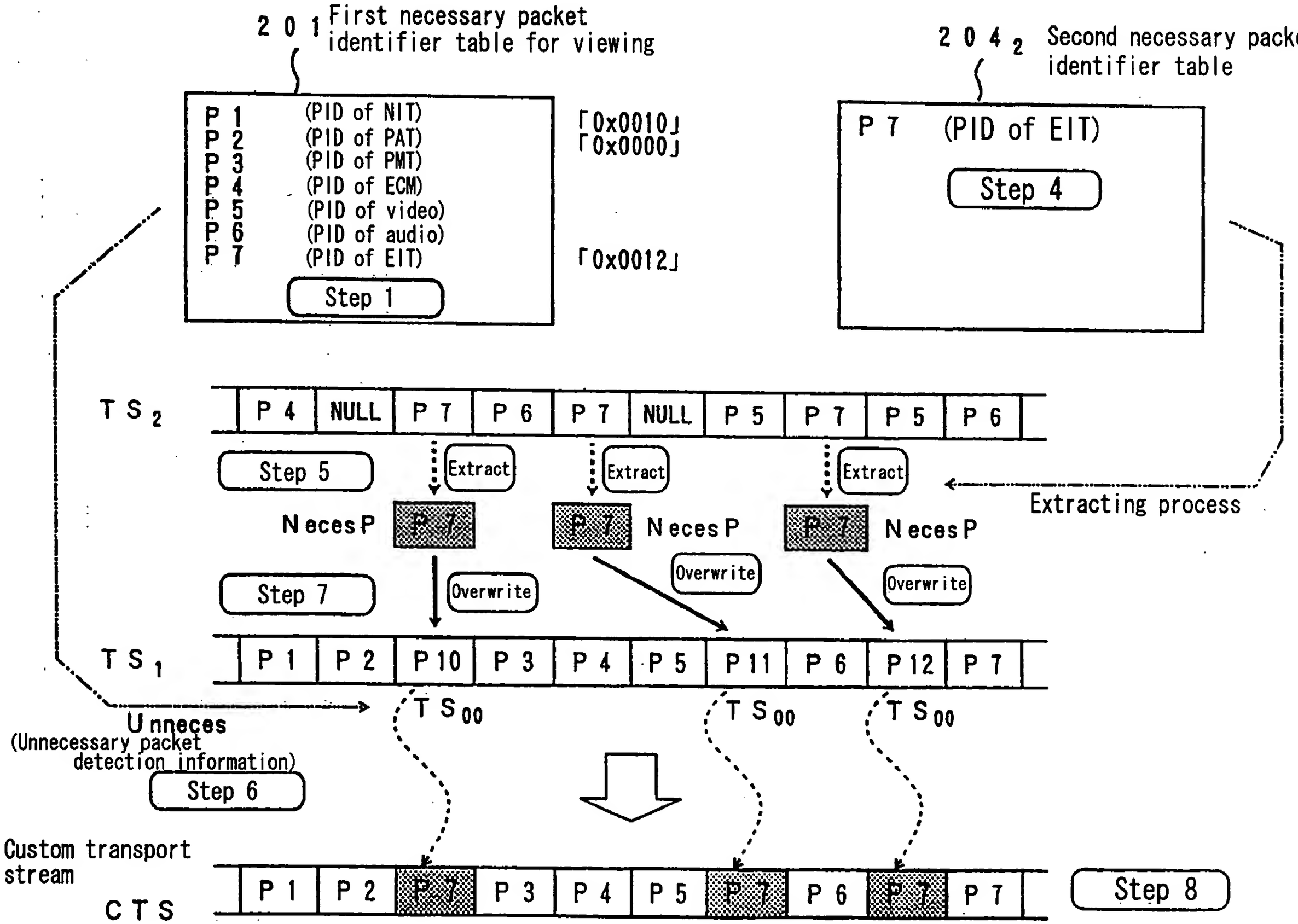
【FIG. 3】



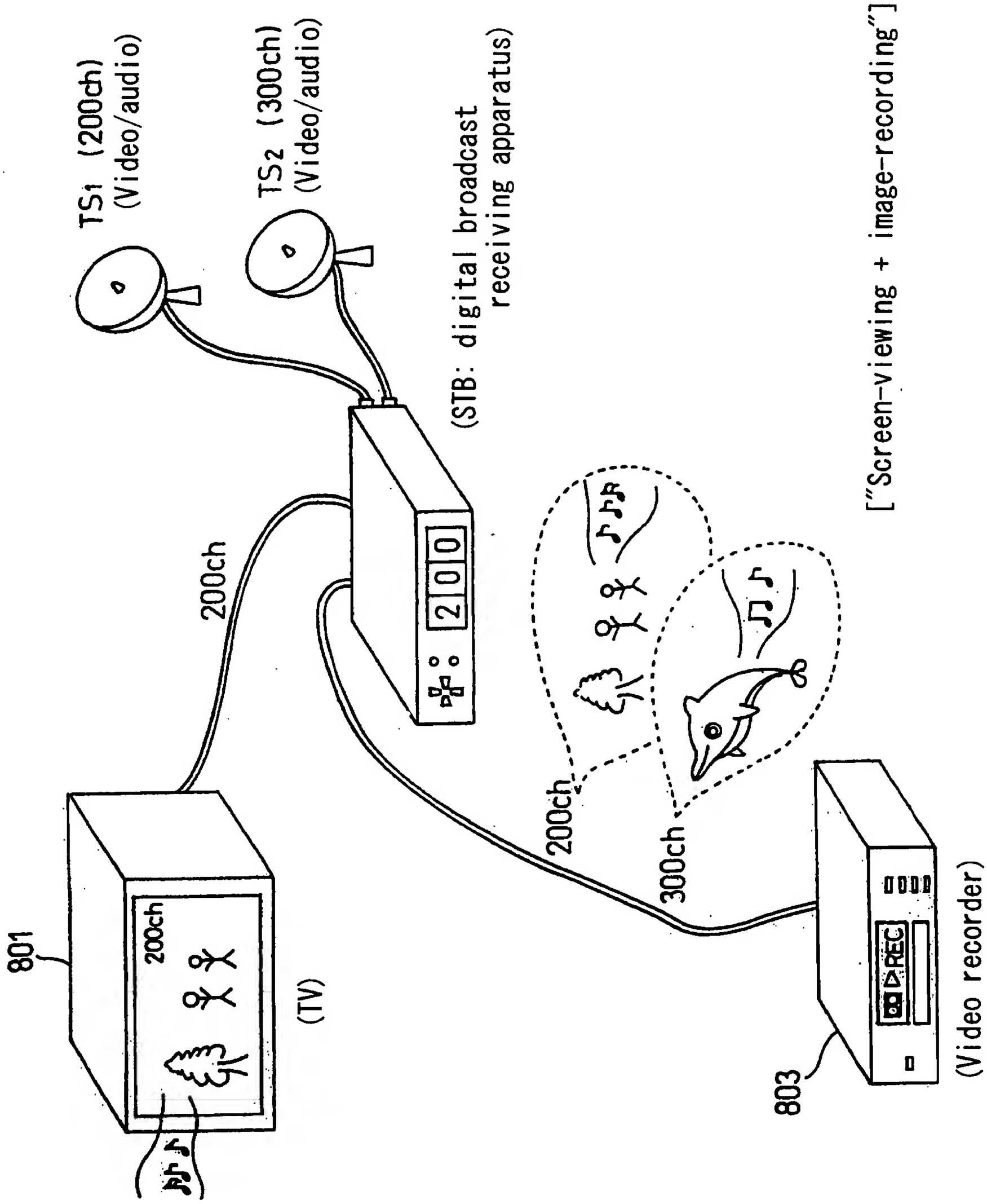
TS1: first transport stream
TS2: second transport stream
PSI: program specification information
NIT: network information table
PAT: program association table
PMT: program map table
ECM: entitlement control message

ES: elementary stream (video signal, audio signal, data signal)
SI: broadcast program layout information
TSP: transport stream packet
PID: packet identifier
EIT: event information table

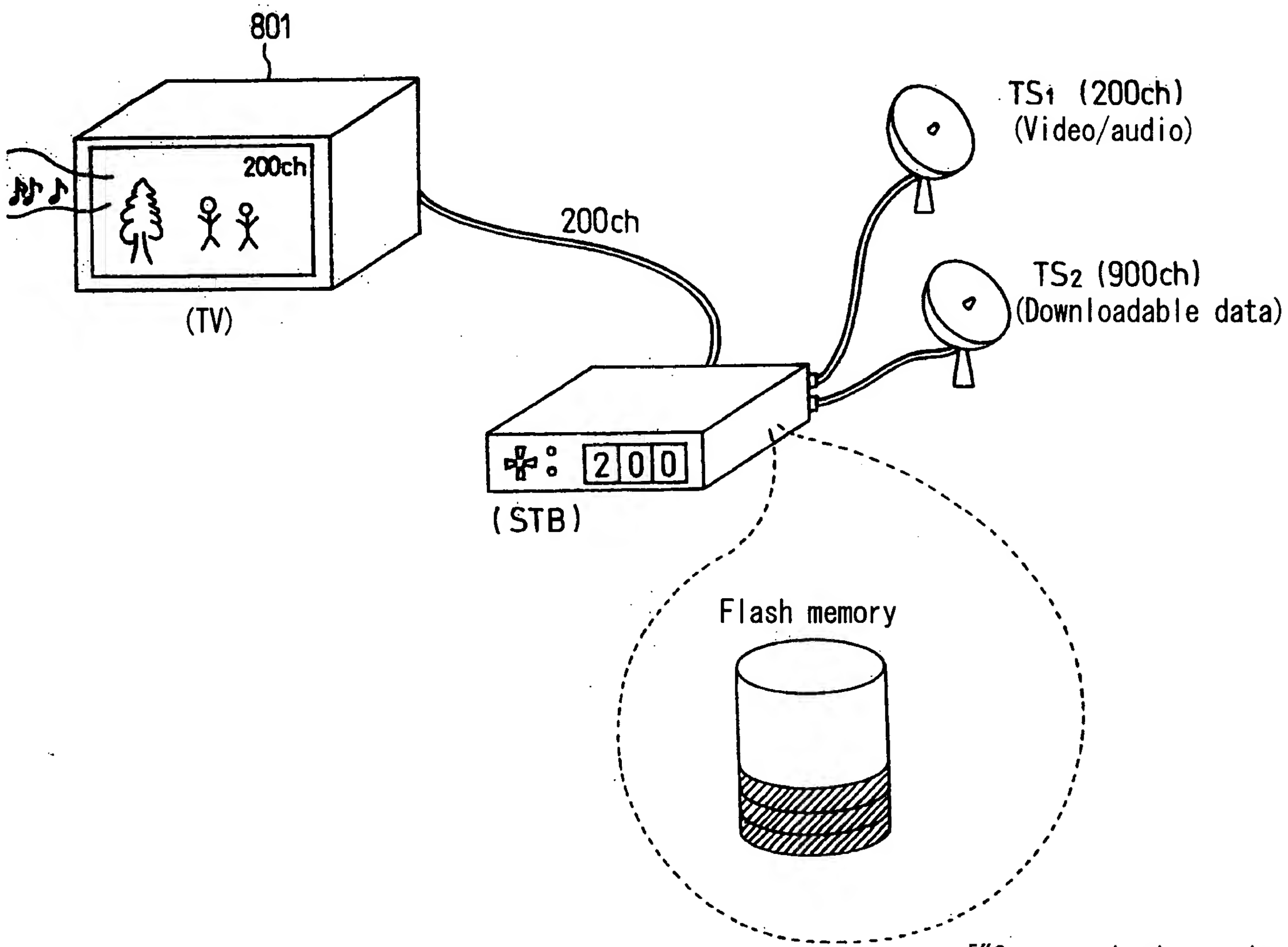
【FIG. 4】


201 First necessary packet identifier table for viewing
P 1 (PID of NIT) 「0x0010」
P 2 (PID of PAT) 「0x0000」
P 3 (PID of PMT)
P 4 (PID of ECM)
P 5 (PID of video)
P 6 (PID of audio)
P 7 (PID of EIT) 「0x0012」
Step 1
202 2 Second necessary packet identifier table
P 7 (PID of EIT)
Step 4
TS 2
P 4 NULL P 7 P 6 P 7 NULL P 5 P 7 P 5 P 6
Step 5
Extract
Extract
Extract
Extracting process
NecesP
P 7
NecesP
P 7
NecesP
P 7
Step 7
Overwrite
Overwrite
Overwrite
TS 1
P 1 P 2 P 10 P 3 P 4 P 5 P 11 P 6 P 12 P 7
TS 00
TS 00
TS 00
Unneces
(Unnecessary packet detection information)
Step 6
Custom transport stream
CTS
P 1 P 2 P 7 P 3 P 4 P 5 P 7 P 6 P 7 P 7
Step 8

【FIG. 5】

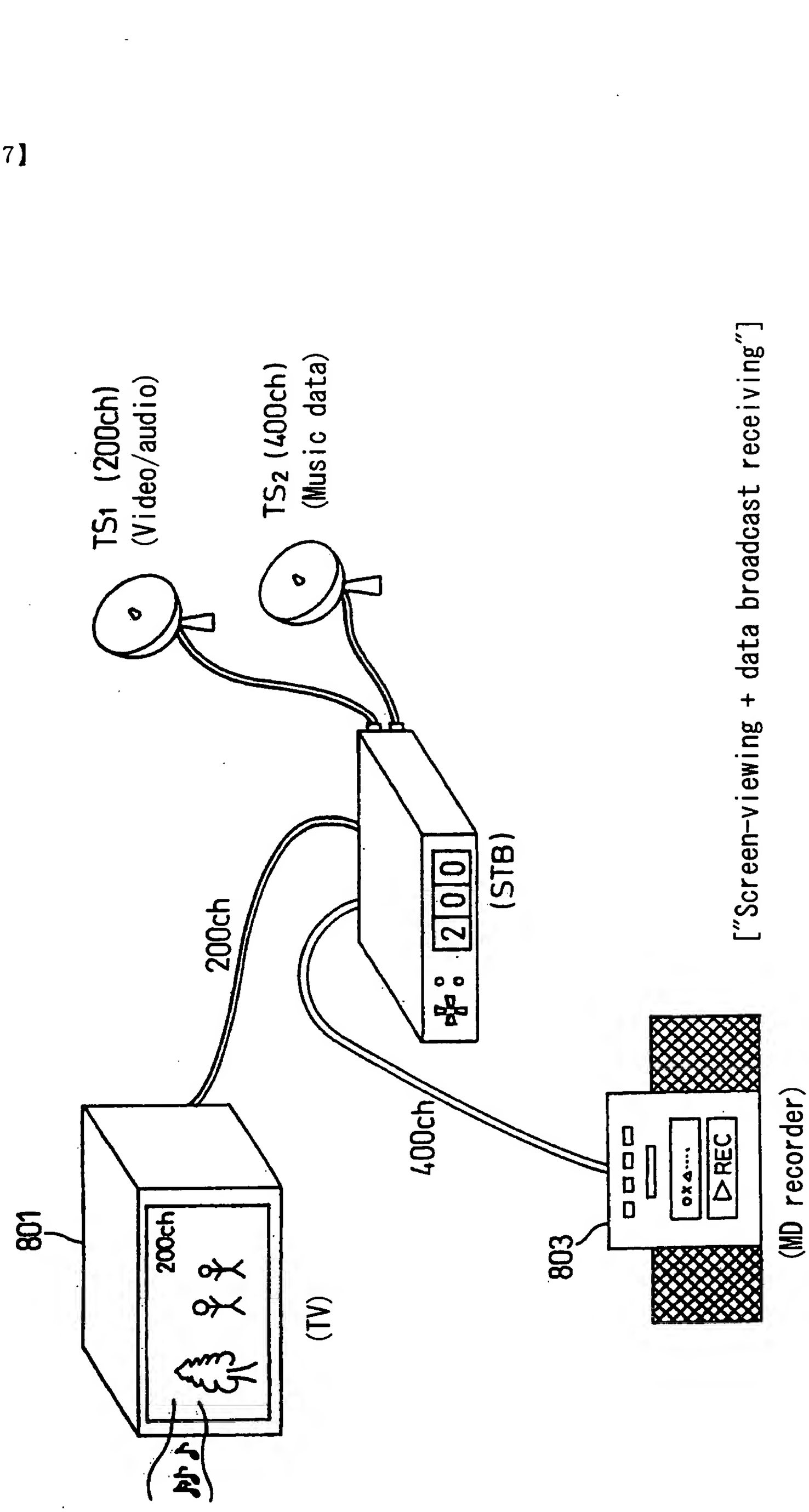

TS1 (200ch) (Video/audio)
TS2 (300ch) (Video/audio)
(STB: digital broadcast receiving apparatus)
200ch
200ch
300ch
801
200ch
(TV)
803
(Video recorder)
["Screen-viewing + image-recording"]

【FIG. 6】

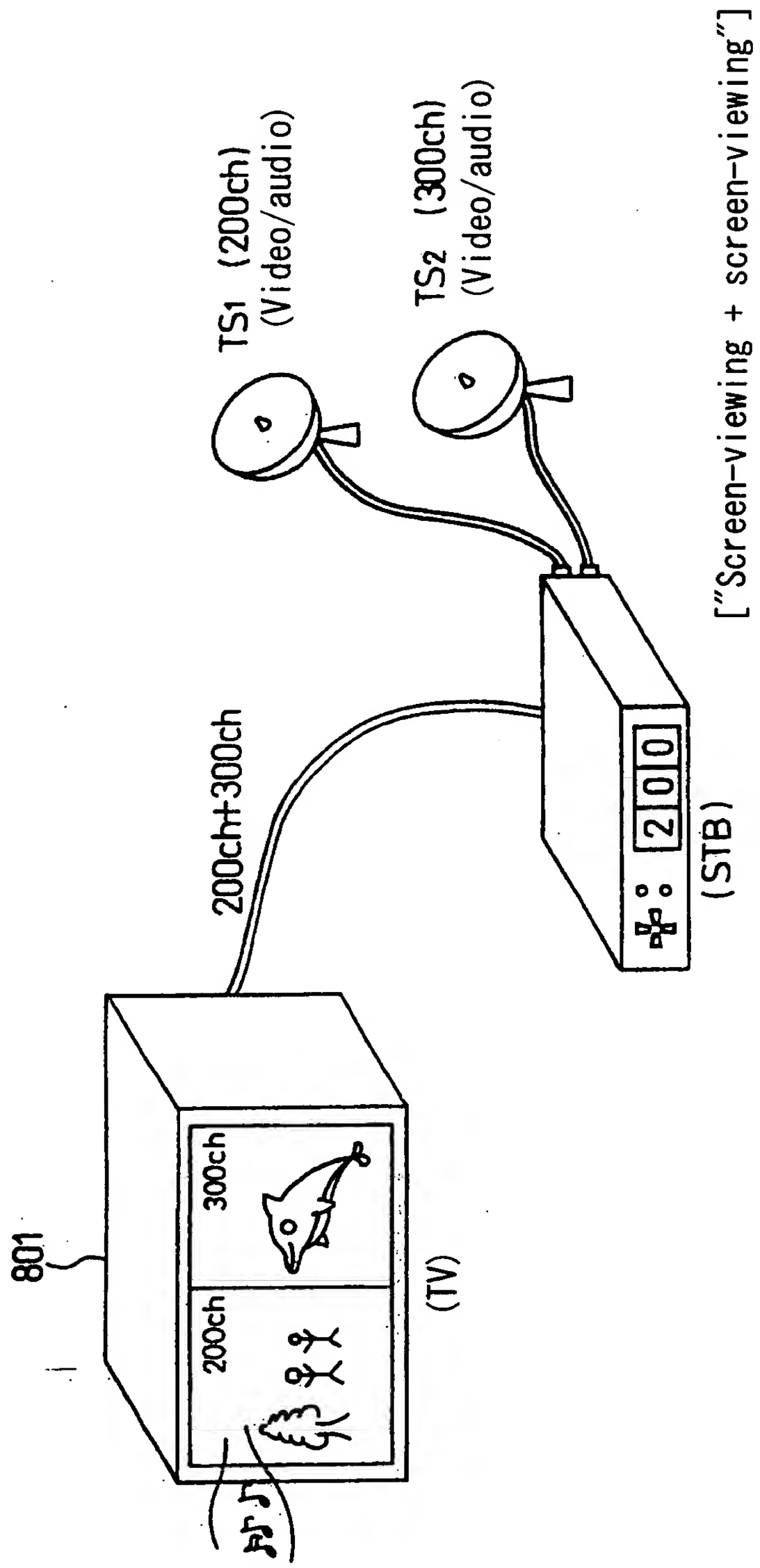


["Screen-viewing + downloading"]

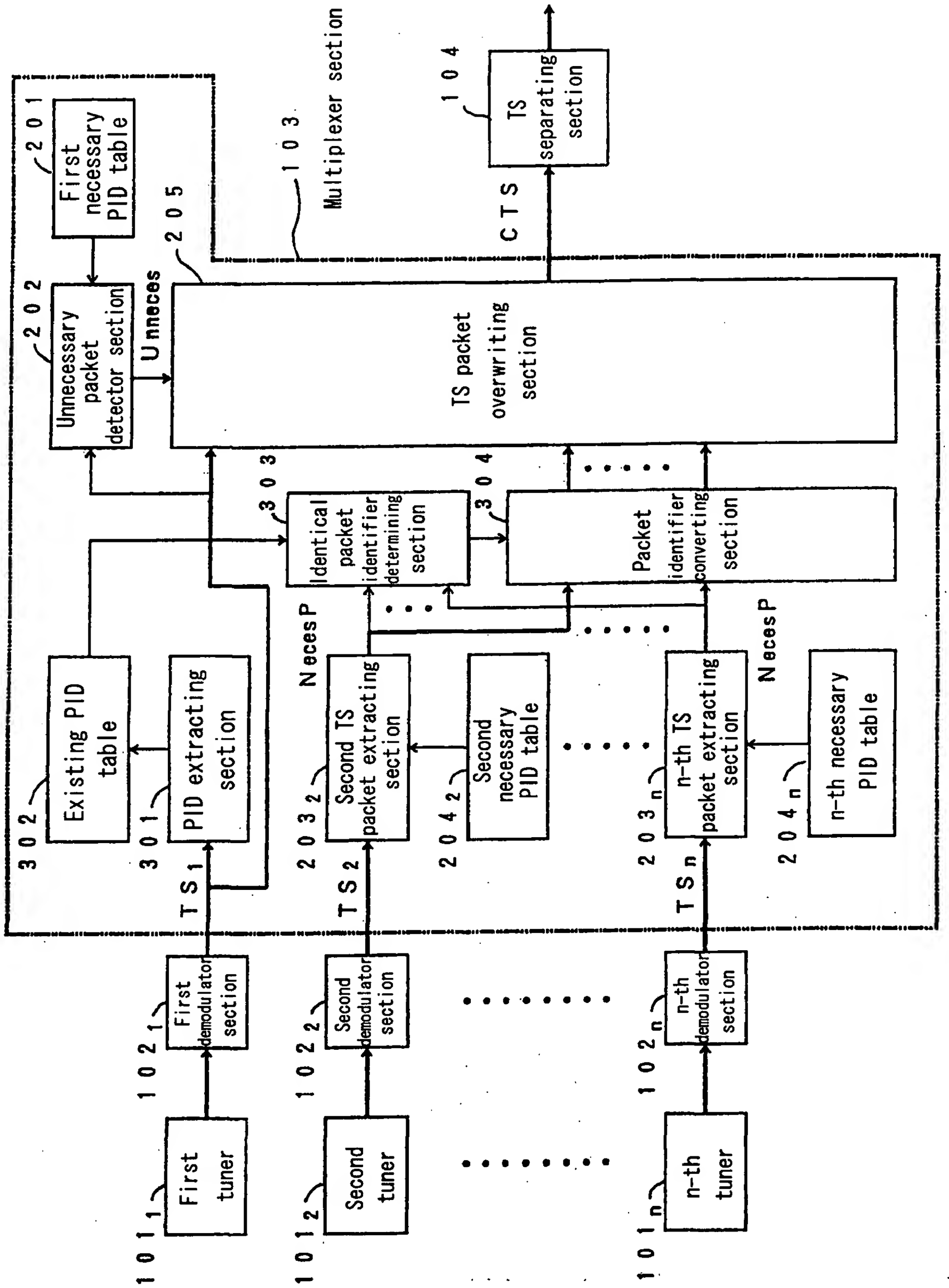
【FIG. 7】


TS1 (200ch)
(Video/audio)
TS2 (400ch)
(Music data)
200ch
400ch
200
(STB)
["Screen-viewing + data broadcast receiving"]
801
200ch
(TV)
803
REC
(MD recorder)

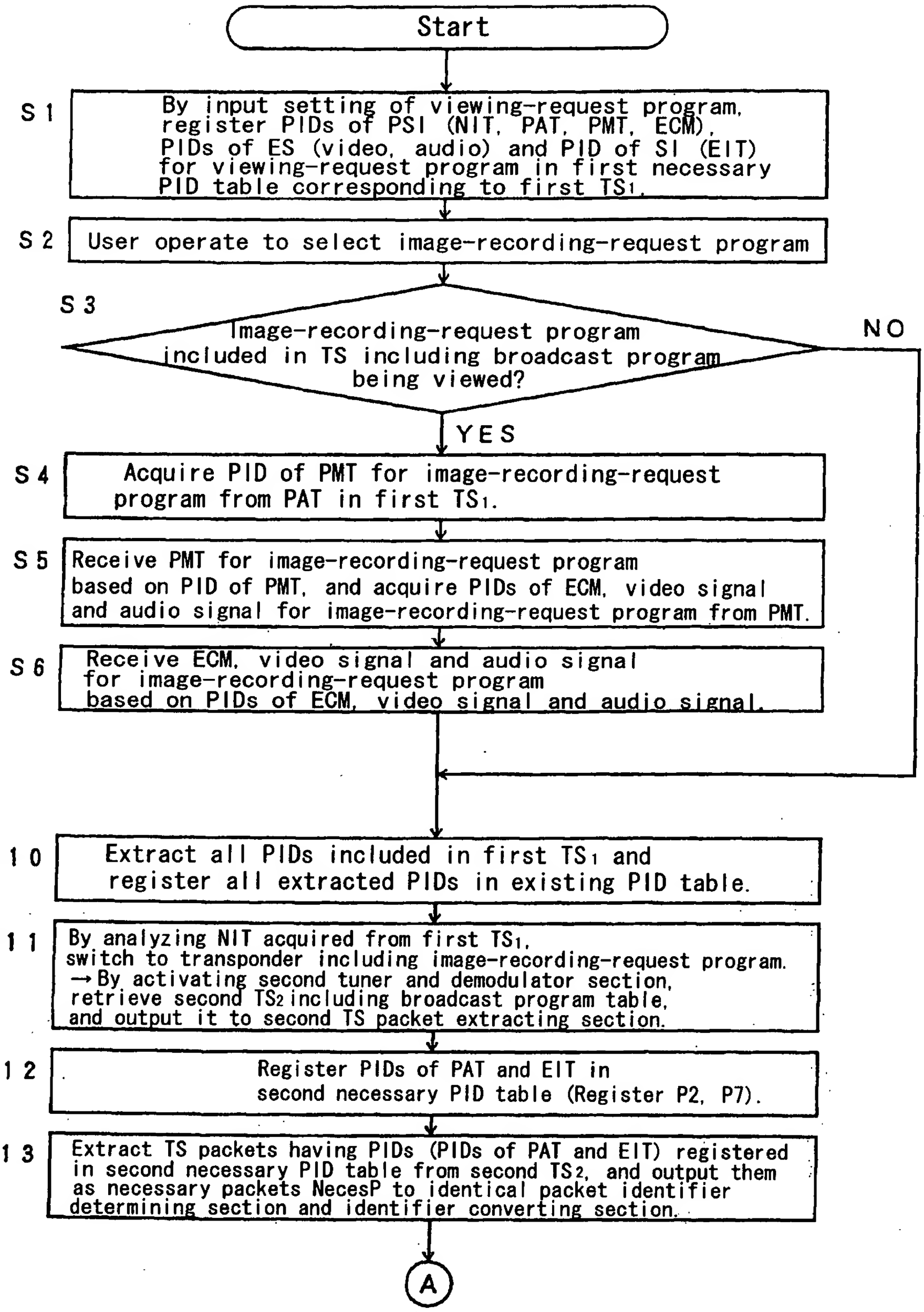
【FIG. 8】


TS1 (200ch) (Video/audio)
TS2 (300ch) (Video/audio)
["Screen-viewing + screen-viewing"]
200ch+300ch
(STB)
801
300ch
200ch
(TV)

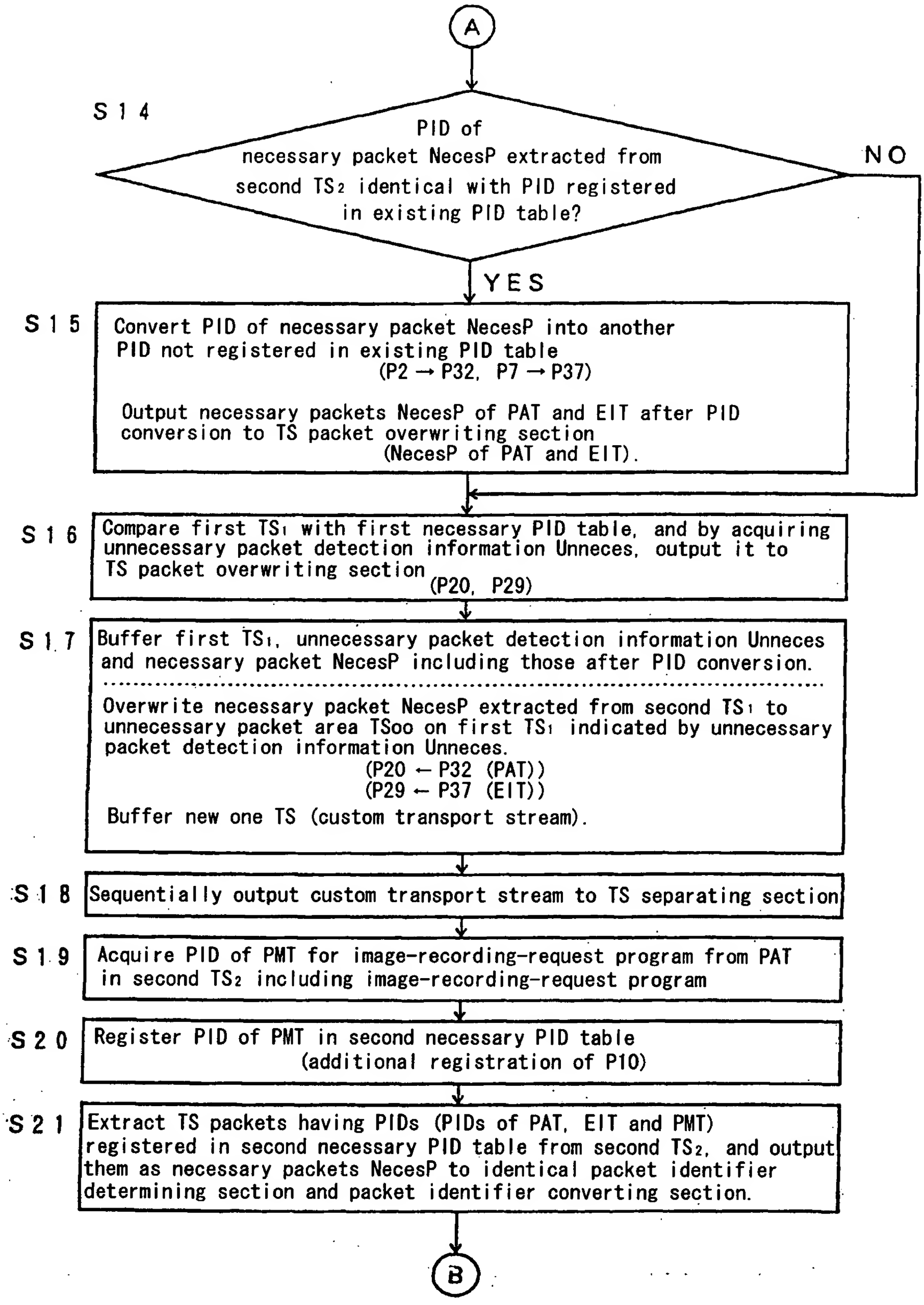
【FIG. 9】


101 1
First tuner
102 1
First demodulator section
101 2
Second tuner
102 2
Second demodulator section
101 n
n-th tuner
102 n
n-th demodulator section
TS 1
TS 2
TS n
301
PID extracting section
302
Existing PID table
2032
Second TS packet extracting section
2042
Second necessary PID table
203n
n-th TS packet extracting section
204n
n-th necessary PID table
303
Identical packet identifier determining section
304
Packet identifier converting section
201
First necessary PID table
202
Unnecessary packet detector section
205
TS packet overwriting section
103
Multiplexer section
104
TS separating section
CTS

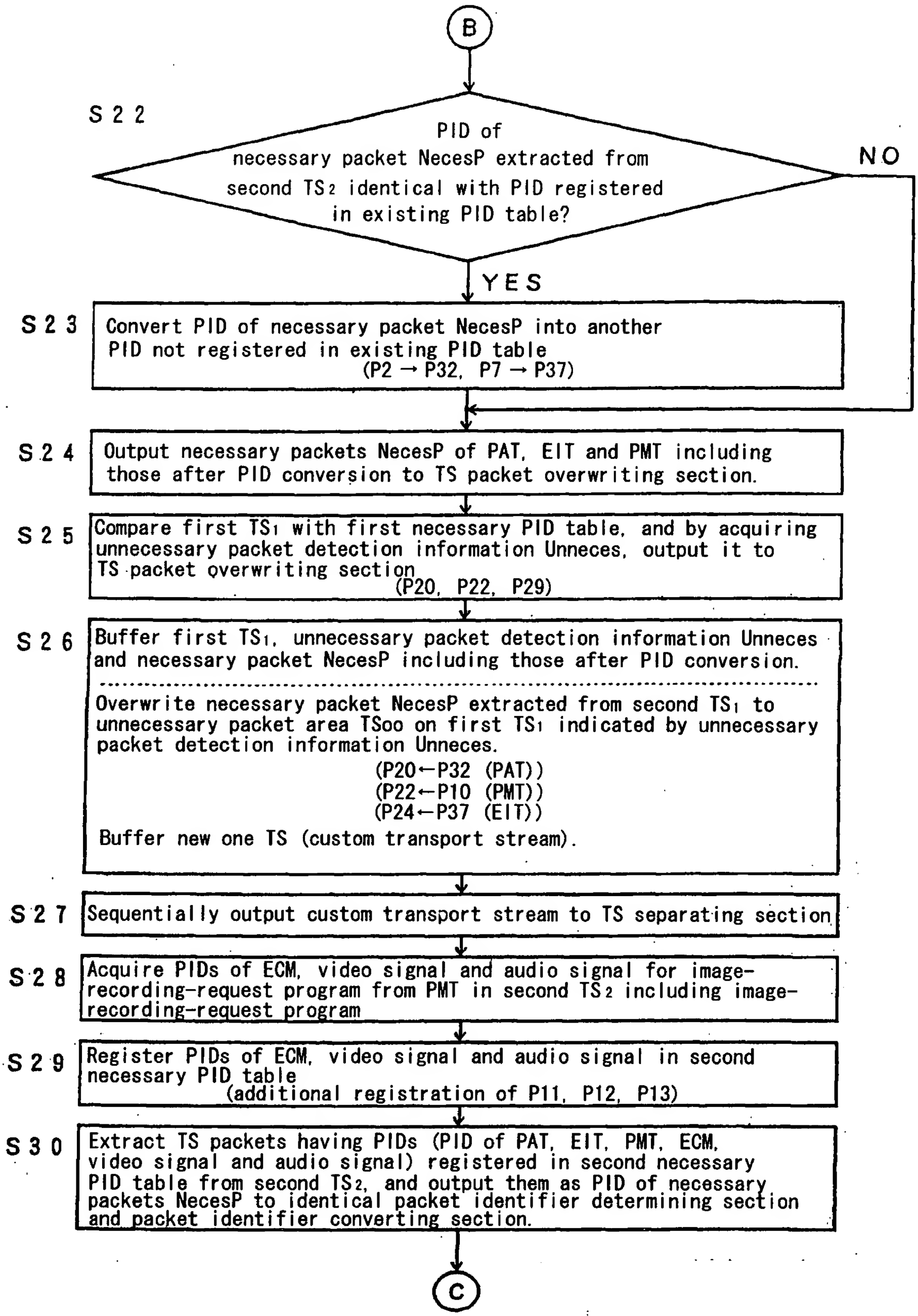
【FIG. 10】


Start
S 1
By input setting of viewing-request program, register PIDs of PSI (NIT, PAT, PMT, ECM), PIDs of ES (video, audio) and PID of SI (EIT) for viewing-request program in first necessary PID table corresponding to first TS1.
S 2
User operate to select image-recording-request program
S 3
Image-recording-request program included in TS including broadcast program being viewed?
NO
YES
S 4
Acquire PID of PMT for image-recording-request program from PAT in first TS1.
S 5
Receive PMT for image-recording-request program based on PID of PMT, and acquire PIDs of ECM, video signal and audio signal for image-recording-request program from PMT.
S 6
Receive ECM, video signal and audio signal for image-recording-request program based on PIDs of ECM, video signal and audio signal.
S 10
Extract all PIDs included in first TS1 and register all extracted PIDs in existing PID table.
S 11
By analyzing NIT acquired from first TS1, switch to transponder including image-recording-request program.
→By activating second tuner and demodulator section, retrieve second TS2 including broadcast program table, and output it to second TS packet extracting section.
S 12
Register PIDs of PAT and EIT in second necessary PID table (Register P2, P7).
S 13
Extract TS packets having PIDs (PIDs of PAT and EIT) registered in second necessary PID table from second TS2, and output them as necessary packets NecesP to identical packet identifier determining section and identifier converting section.
A

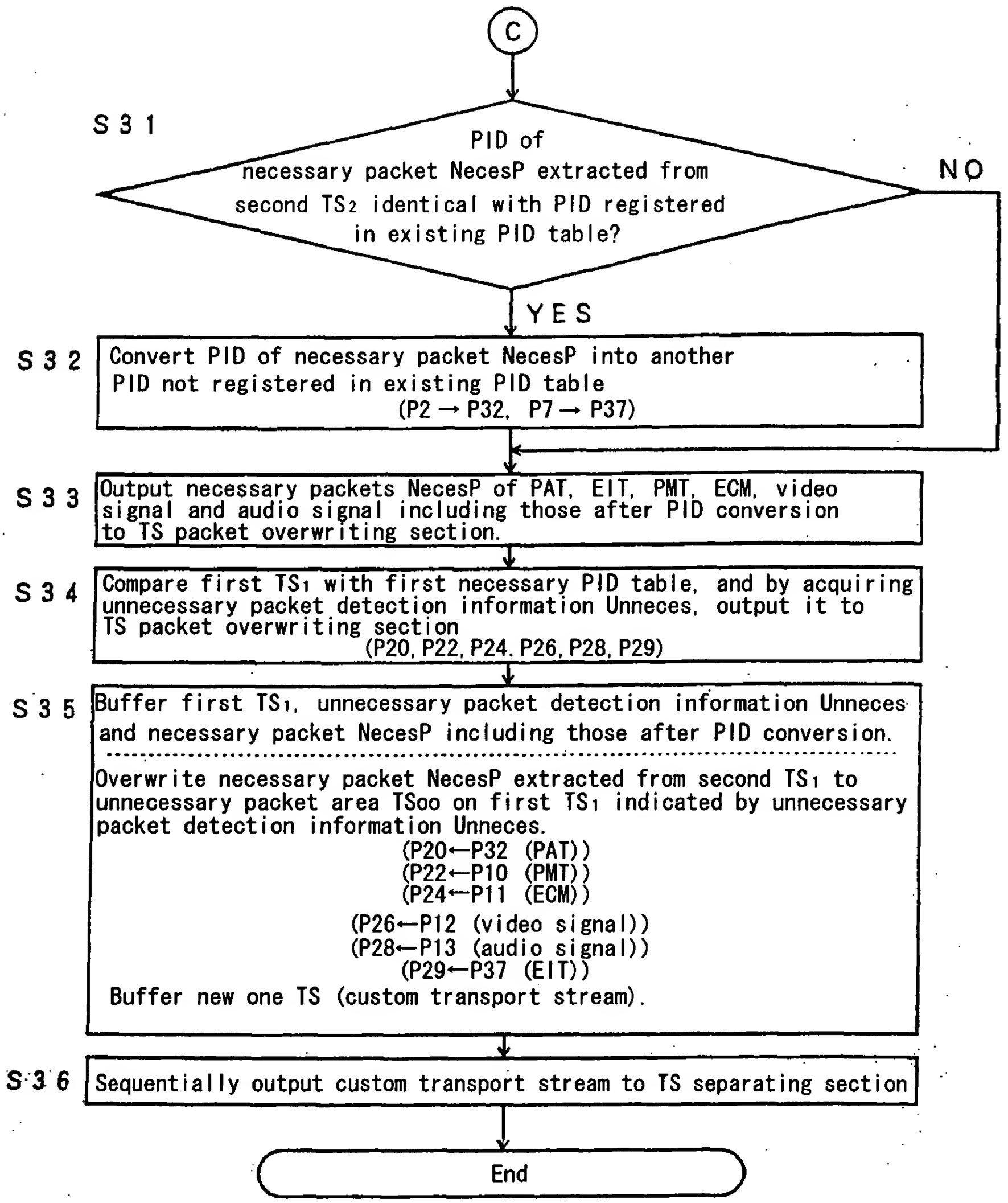
【FIG. 11】


A
S14
PID of necessary packet NecesP extracted from second TS2 identical with PID registered in existing PID table?
NO
YES
S15
Convert PID of necessary packet NecesP into another PID not registered in existing PID table (P2 → P32, P7 → P37)
Output necessary packets NecesP of PAT and EIT after PID conversion to TS packet overwriting section (NecesP of PAT and EIT).
S16
Compare first TS1 with first necessary PID table, and by acquiring unnecessary packet detection information Unneces, output it to TS packet overwriting section (P20, P29)
S17
Buffer first TS1, unnecessary packet detection information Unneces and necessary packet NecesP including those after PID conversion.
Overwrite necessary packet NecesP extracted from second TS1 to unnecessary packet area TSoo on first TS1 indicated by unnecessary packet detection information Unneces.
(P20 ← P32 (PAT))
(P29 ← P37 (EIT))
Buffer new one TS (custom transport stream).
S18
Sequentially output custom transport stream to TS separating section
S19
Acquire PID of PMT for image-recording-request program from PAT in second TS2 including image-recording-request program
S20
Register PID of PMT in second necessary PID table (additional registration of P10)
S21
Extract TS packets having PIDs (PIDs of PAT, EIT and PMT) registered in second necessary PID table from second TS2, and output them as necessary packets NecesP to identical packet identifier determining section and packet identifier converting section.
B

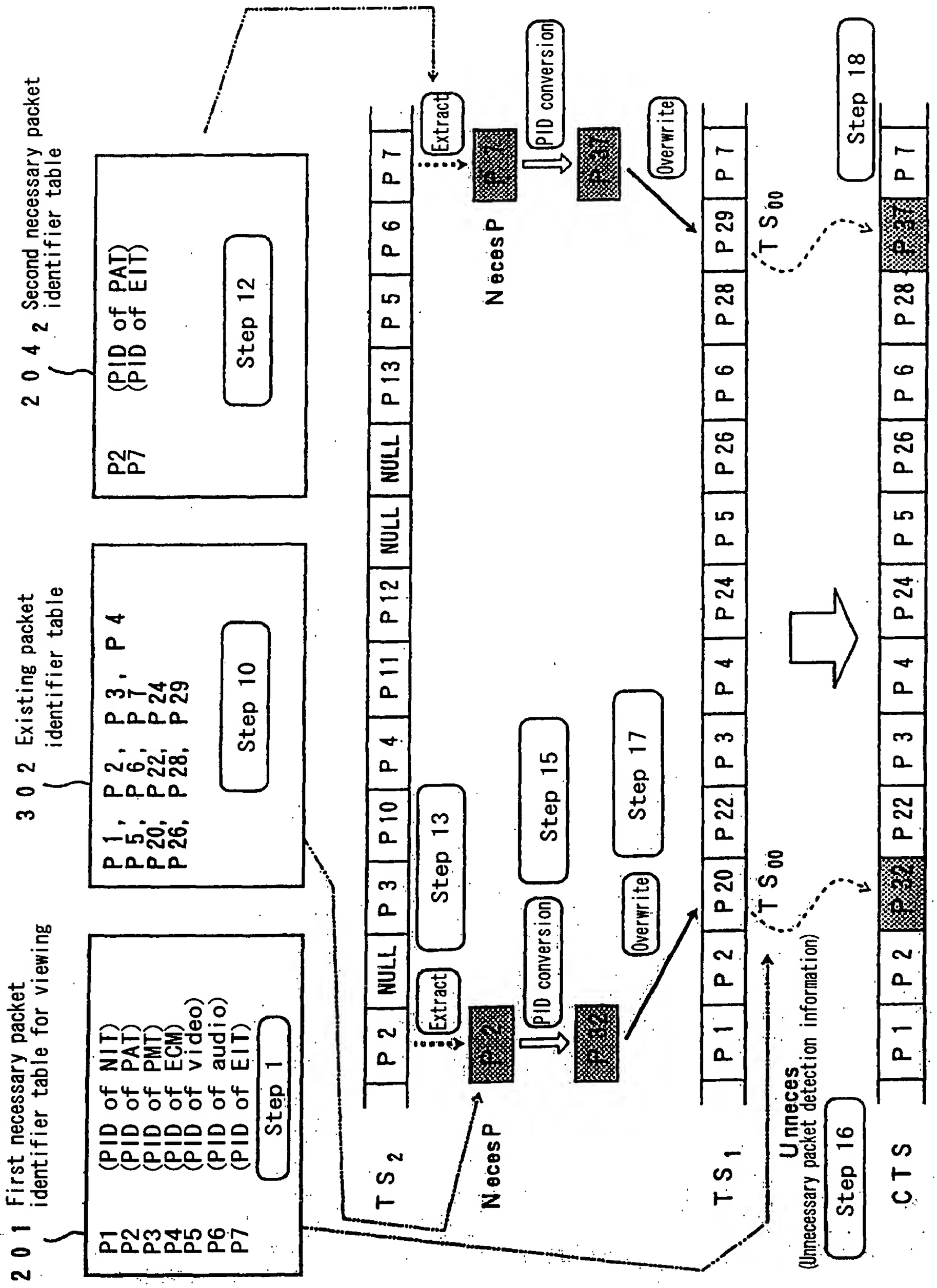
【FIG. 12】


B
S22
PID of necessary packet NecesP extracted from second TS2 identical with PID registered in existing PID table?
NO
YES
S23
Convert PID of necessary packet NecesP into another PID not registered in existing PID table (P2 → P32, P7 → P37)
S24
Output necessary packets NecesP of PAT, EIT and PMT including those after PID conversion to TS packet overwriting section.
S25
Compare first TS1 with first necessary PID table, and by acquiring unnecessary packet detection information Unneces, output it to TS packet overwriting section (P20, P22, P29)
S26
Buffer first TS1, unnecessary packet detection information Unneces and necessary packet NecesP including those after PID conversion.
Overwrite necessary packet NecesP extracted from second TS1 to unnecessary packet area TSoo on first TS1 indicated by unnecessary packet detection information Unneces.
(P20←P32 (PAT))
(P22←P10 (PMT))
(P24←P37 (EIT))
Buffer new one TS (custom transport stream).
S27
Sequentially output custom transport stream to TS separating section
S28
Acquire PIDs of ECM, video signal and audio signal for image-recording-request program from PMT in second TS2 including image-recording-request program
S29
Register PIDs of ECM, video signal and audio signal in second necessary PID table (additional registration of P11, P12, P13)
S30
Extract TS packets having PIDs (PID of PAT, EIT, PMT, ECM, video signal and audio signal) registered in second necessary PID table from second TS2, and output them as PID of necessary packets NecesP to identical packet identifier determining section and packet identifier converting section.
C

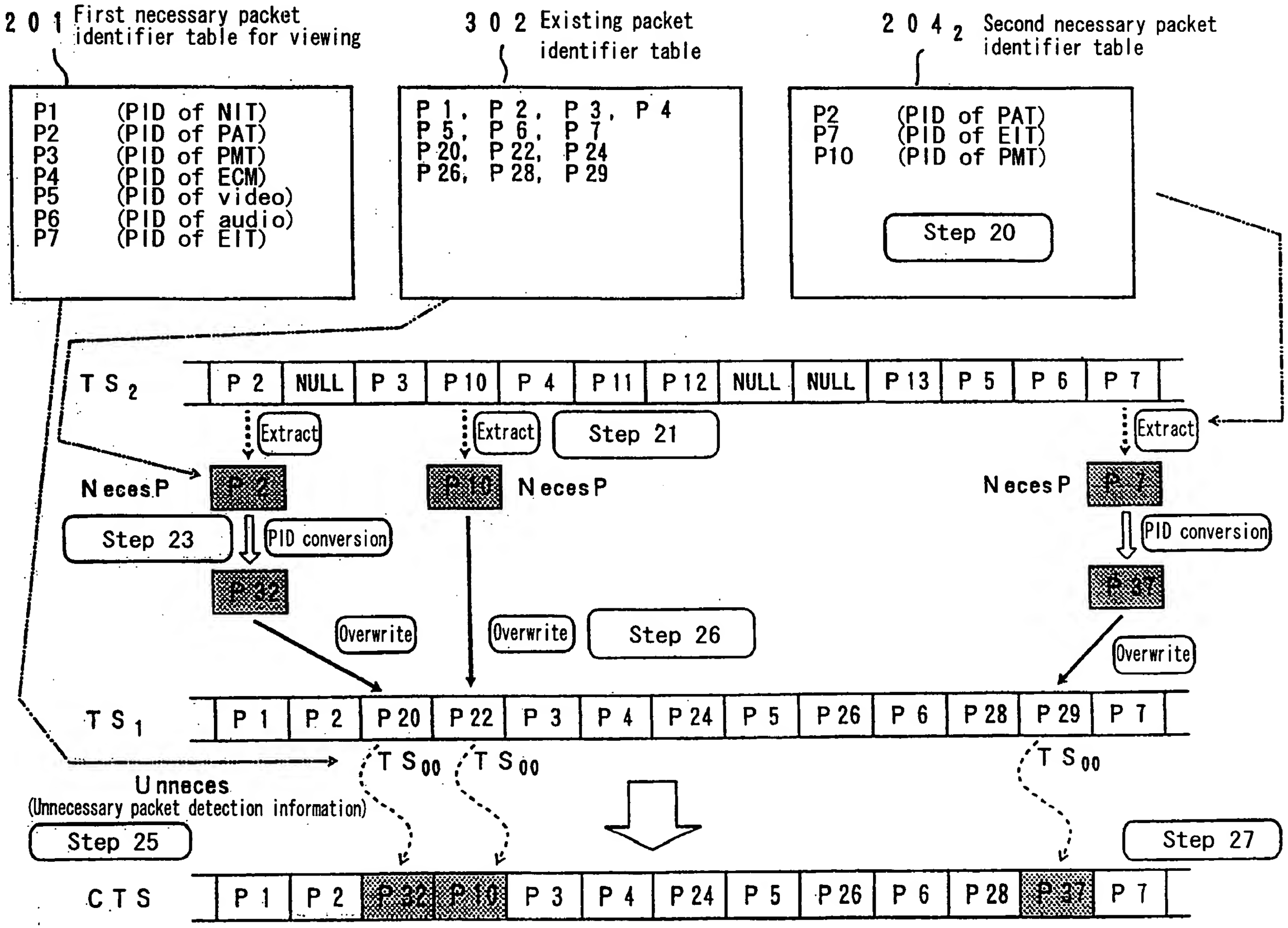
【FIG. 13】


C
S31
PID of necessary packet NecesP extracted from second TS2 identical with PID registered in existing PID table?
NO
YES
S32
Convert PID of necessary packet NecesP into another PID not registered in existing PID table
(P2 → P32, P7 → P37)
S33
Output necessary packets NecesP of PAT, EIT, PMT, ECM, video signal and audio signal including those after PID conversion to TS packet overwriting section.
S34
Compare first TS1 with first necessary PID table, and by acquiring unnecessary packet detection information Unneces, output it to TS packet overwriting section
(P20, P22, P24, P26, P28, P29)
S35
Buffer first TS1, unnecessary packet detection information Unneces and necessary packet NecesP including those after PID conversion.
Overwrite necessary packet NecesP extracted from second TS1 to unnecessary packet area TSoo on first TS1 indicated by unnecessary packet detection information Unneces.
(P20←P32 (PAT))
(P22←P10 (PMT))
(P24←P11 (ECM))
(P26←P12 (video signal))
(P28←P13 (audio signal))
(P29←P37 (EIT))
Buffer new one TS (custom transport stream).
S36
Sequentially output custom transport stream to TS separating section
End

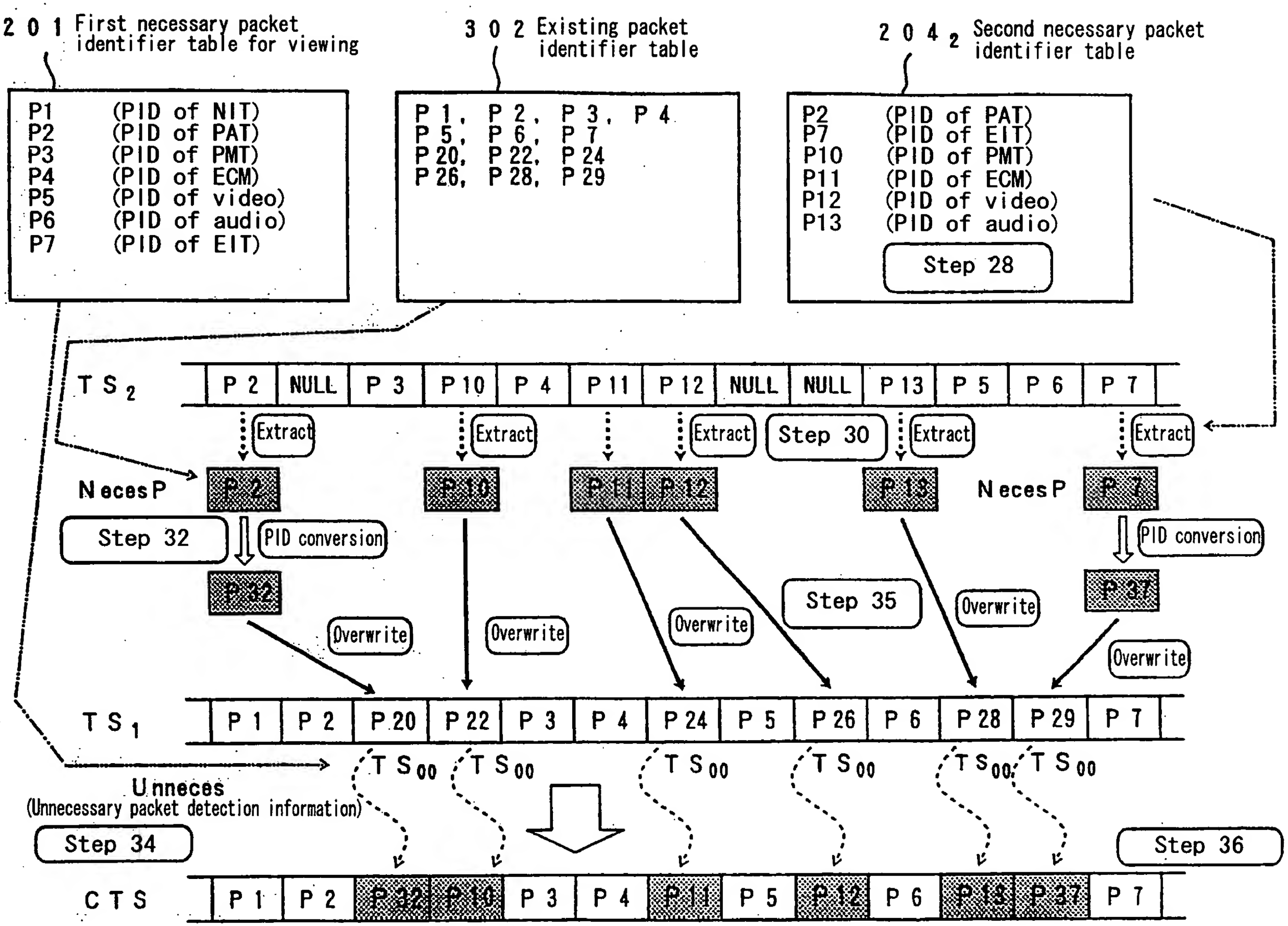
【FIG. 14】


201 First necessary packet identifier table for viewing
(PID of NIT)
(PID of PAT)
(PID of PMT)
(PID of ECM)
(PID of video)
(PID of audio)
(PID of EIT)
P1
P2
P3
P4
P5
P6
P7
Step 1
302 Existing packet identifier table
P 1, P 2, P 3, P 4
P 5, P 6, P 7
P 20, P 22, P 24
P 26, P 28, P 29
Step 10
204 2 Second necessary packet identifier table
(PID of PAT)
(PID of EIT)
P2
P7
Step 12
TS2
P 2
NULL
P 3
P 4
P 10
P 11
P 12
NULL
NULL
P 13
Extract
NecesP
PID conversion
Step 13
Step 15
Step 17
Overwrite
TS1
P 1
P 2
P 20
P 22
P 3
P 4
P 24
P 5
P 26
P 6
P 28
P 29
P 7
TS00
Unneces
(Unnecessary packet detection information)
Step 16
Step 18
CTS

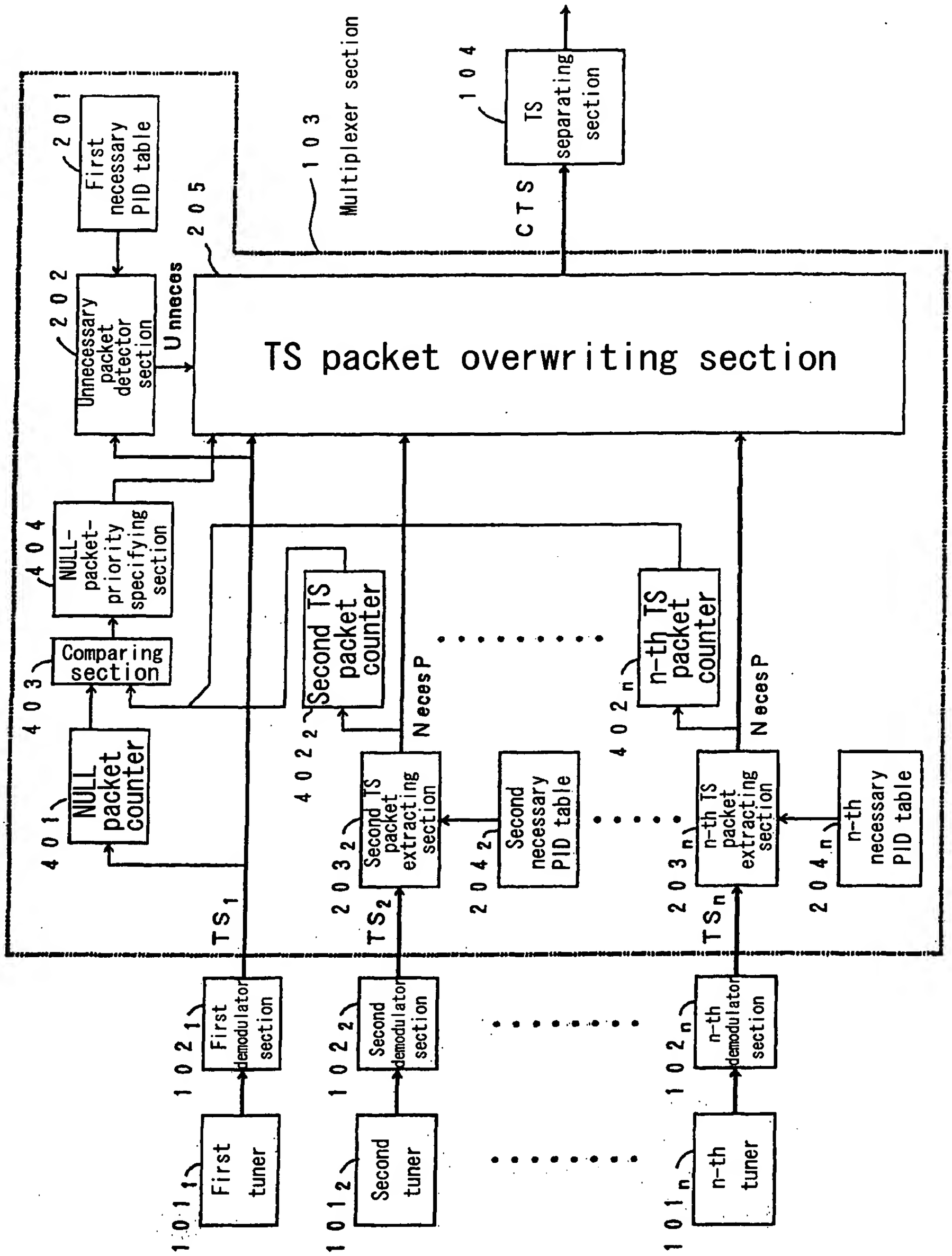
【FIG. 15】


201 First necessary packet identifier table for viewing
P1 (PID of NIT)
P2 (PID of PAT)
P3 (PID of PMT)
P4 (PID of ECM)
P5 (PID of video)
P6 (PID of audio)
P7 (PID of EIT)
302 Existing packet identifier table
P 1, P 2, P 3, P 4
P 5, P 6, P 7
P 20, P 22, P 24
P 26, P 28, P 29
204 2 Second necessary packet identifier table
P2 (PID of PAT)
P7 (PID of EIT)
P10 (PID of PMT)
Step 20
TS 2
P 2 NULL P 3 P 10 P 4 P 11 P 12 NULL NULL P 13 P 5 P 6 P 7
Extract
Extract
Step 21
Extract
NecesP
P 2
P 10
NecesP
NecesP
P 7
Step 23
PID conversion
PID conversion
P 32
P 37
Overwrite
Overwrite
Step 26
Overwrite
TS 1
P 1 P 2 P 20 P 22 P 3 P 4 P 24 P 5 P 26 P 6 P 28 P 29 P 7
TS 00
TS 00
TS 00
Unneces
(Unnecessary packet detection information)
Step 25
Step 27
CTS
P 1 P 2 P 32 P 10 P 3 P 4 P 24 P 5 P 26 P 6 P 28 P 37 P 7

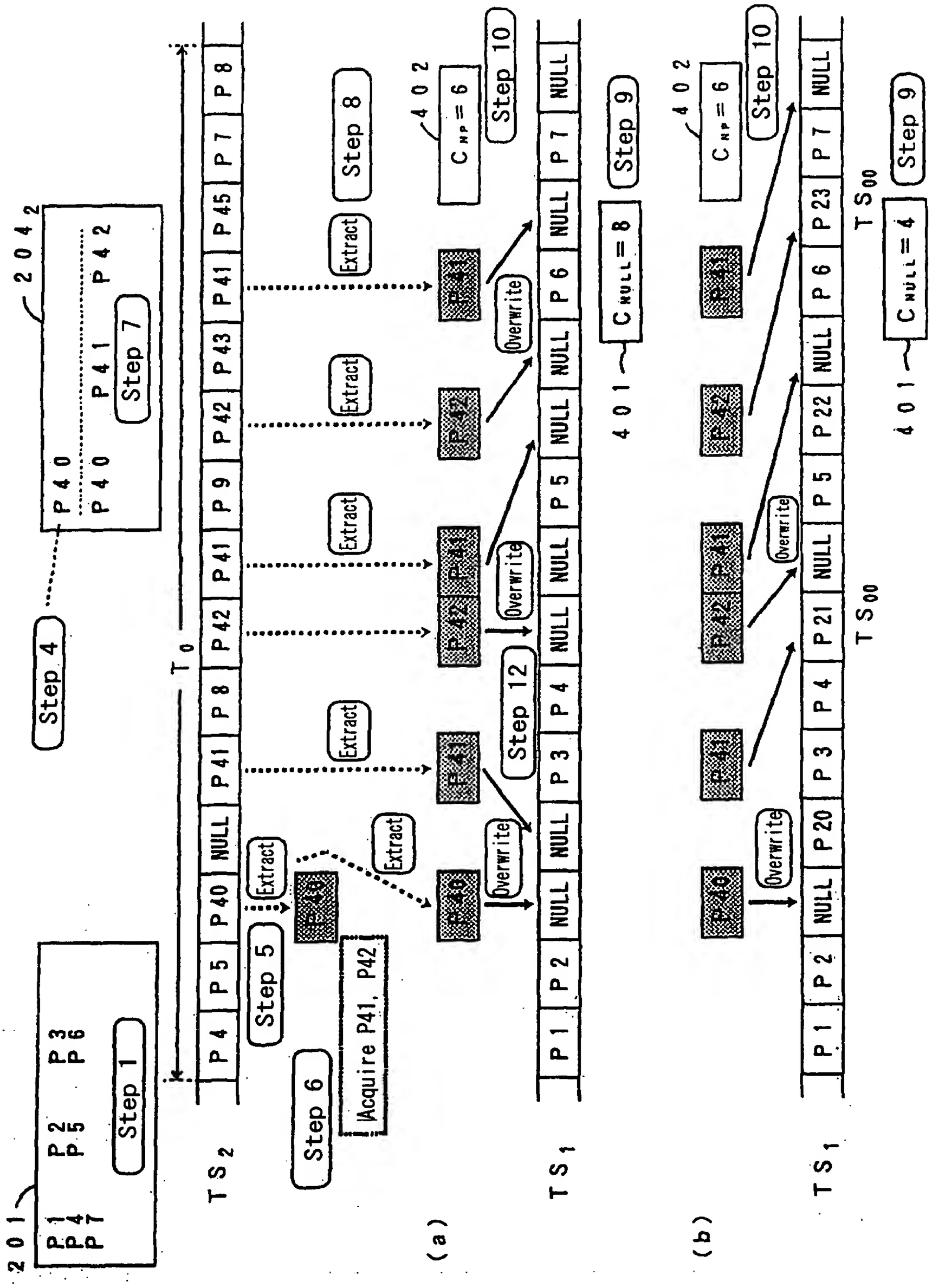
[FIG. 16]


201 First necessary packet identifier table for viewing
P1 (PID of NIT)
P2 (PID of PAT)
P3 (PID of PMT)
P4 (PID of ECM)
P5 (PID of video)
P6 (PID of audio)
P7 (PID of EIT)
302 Existing packet identifier table
P 1, P 2, P 3, P 4
P 5, P 6, P 7
P 20, P 22, P 24
P 26, P 28, P 29
2042 Second necessary packet identifier table
P2 (PID of PAT)
P7 (PID of EIT)
P10 (PID of PMT)
P11 (PID of ECM)
P12 (PID of video)
P13 (PID of audio)
Step 28
TS2
P 2 NULL P 3 P 10 P 4 P 11 P 12 NULL NULL P 13 P 5 P 6 P 7
Extract
Step 30
NecesP
P 2
P 10
P 11 P 12
P 13
NecesP
P 7
Step 32
PID conversion
P 32
P 37
Overwrite
Step 35
TS1
P 1 P 2 P 20 P 22 P 3 P 4 P 24 P 5 P 26 P 6 P 28 P 29 P 7
TS00
Unneces
(Unnecessary packet detection information)
Step 34
Step 36
CTS
P 1 P 2 P 32 P 10 P 3 P 4 P 11 P 5 P 12 P 6 P 13 P 37 P 7

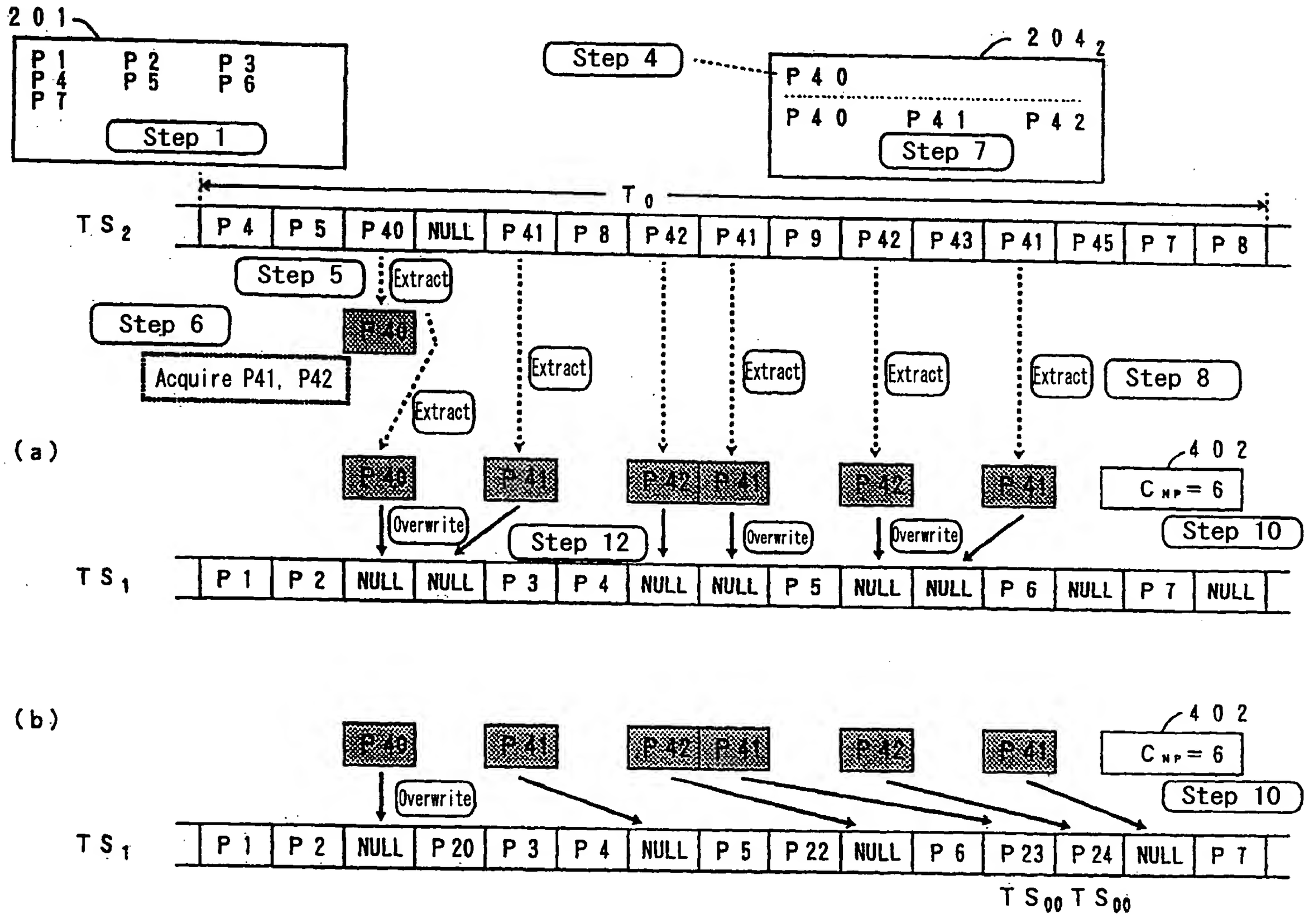
【FIG. 17】


TS packet overwriting section
First tuner
Second tuner
n-th tuner
First demodulator section
Second demodulator section
n-th demodulator section
First necessary PID table
Unnecessary packet detector section
Multiplexer section
TS separating section
CTS
NULL packet counter
Comparing section
NULL-packet-priority specifying section
Second TS packet counter
n-th TS packet counter
Second TS packet extracting section
Second necessary PID table
n-th TS packet extracting section
n-th necessary PID table
Unnecessary
NecesP
TS1
TS2
TSn

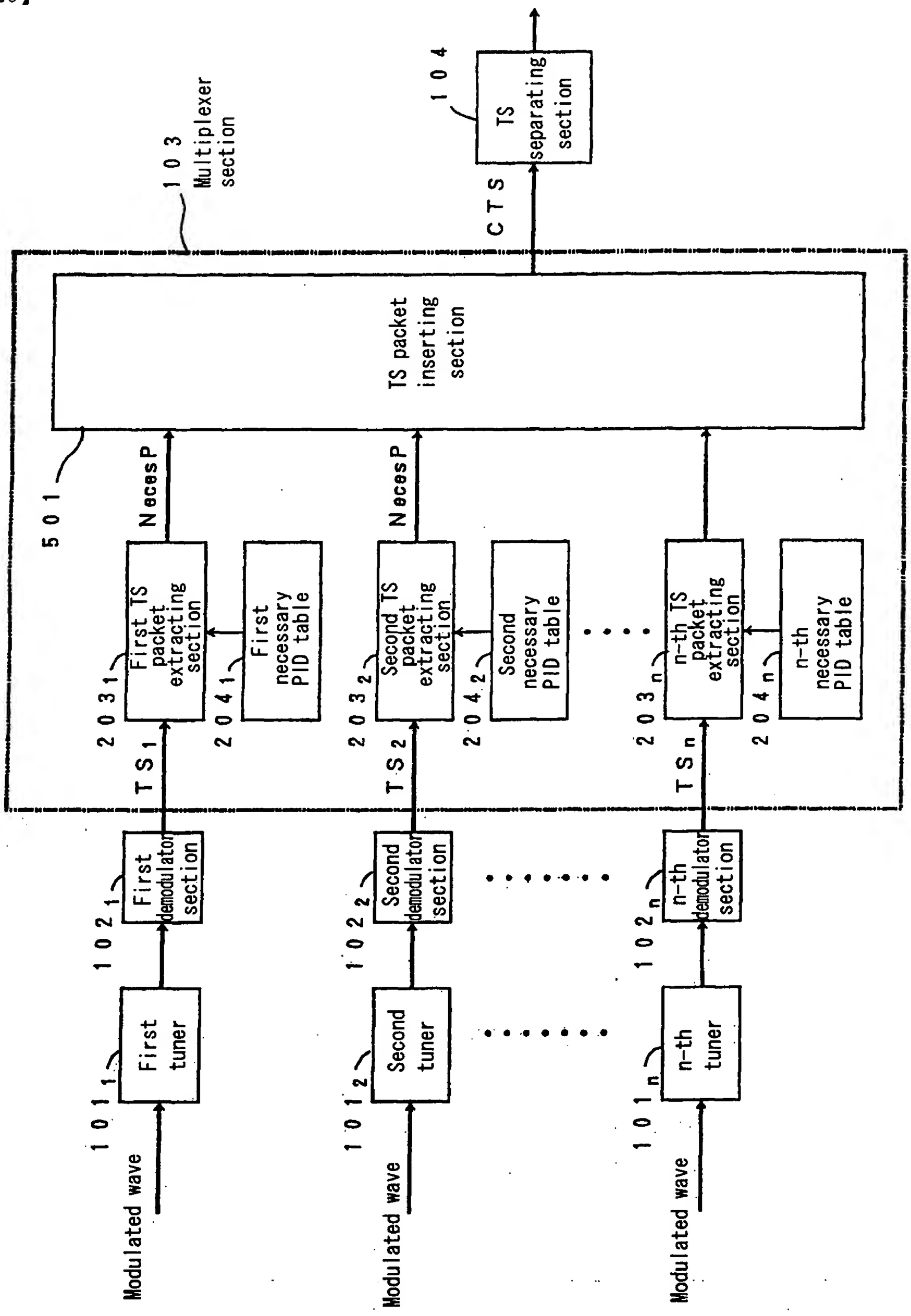
【FIG. 18】


(a)
(b)
TS0
TS1
TS2
T0
Step 1
Step 2
Step 3
Step 4
Step 5
Step 6
Step 7
Step 8
Step 9
Step 10
Step 11
Step 12
Extract
Overwrite
Acquire P41, P42
201
202
401
402
CNULL= 8
CNULL= 4
CNP= 6
NULL

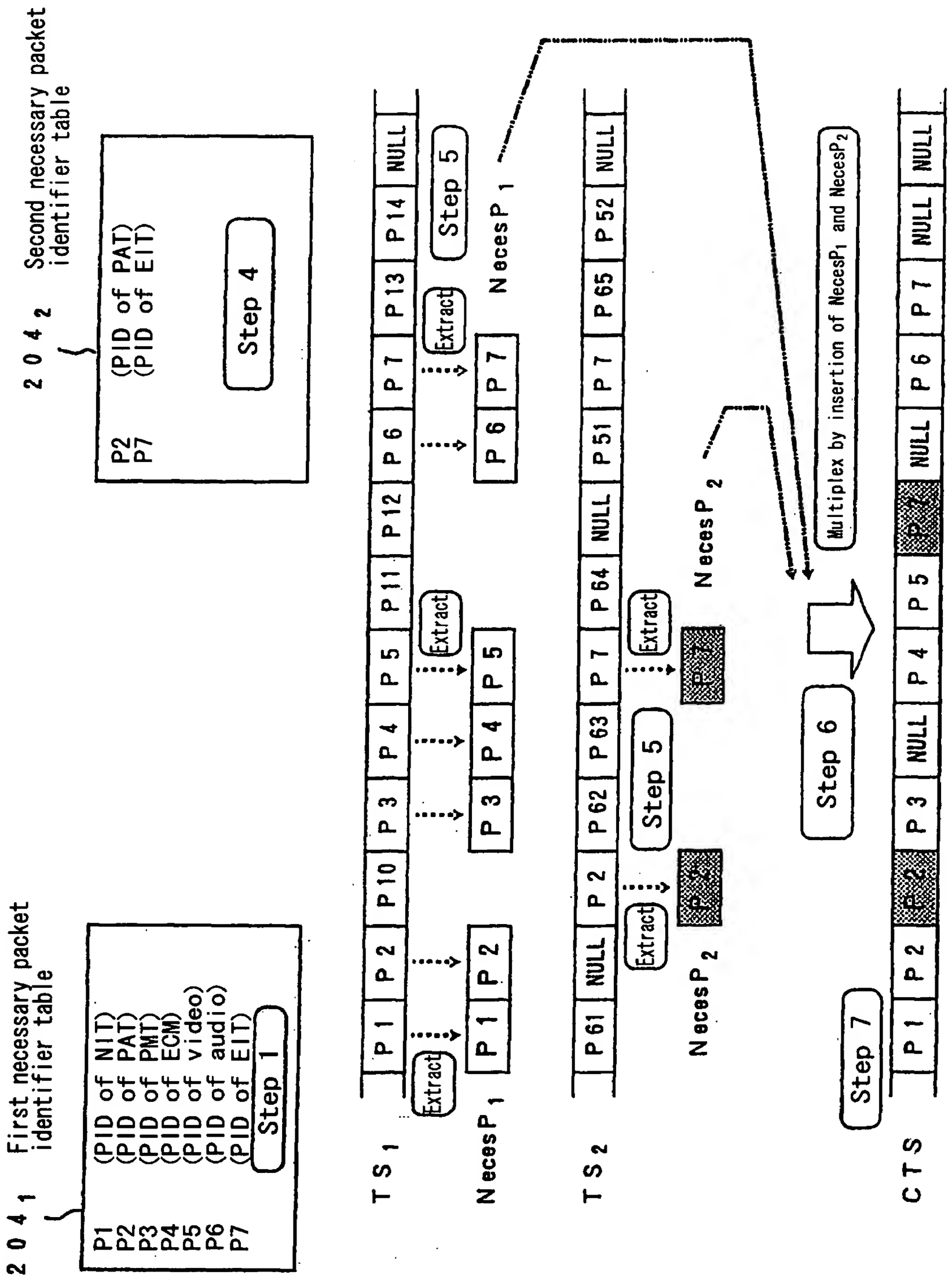
【FIG. 19】


201
P 1 P 2 P 3
P 4 P 5 P 6
P 7
Step 1
Step 4
2042
P 40
P 40 P 41 P 42
Step 7
T0
TS2
P 4 P 5 P 40 NULL P 41 P 8 P 42 P 41 P 9 P 42 P 43 P 41 P 45 P 7 P 8
Step 5
Extract
Step 6
P 40
Acquire P41, P42
Extract
Extract
Extract
Extract
Extract
Step 8
(a)
P 40
P 41
P 42 P 41
P 42
P 41
402
CNP = 6
Step 10
Overwrite
Step 12
Overwrite
Overwrite
TS1
P 1 P 2 NULL NULL P 3 P 4 NULL NULL P 5 NULL NULL P 6 NULL P 7 NULL
(b)
P 40
P 41
P 42 P 41
P 42
P 41
402
CNP = 6
Step 10
Overwrite
TS1
P 1 P 2 NULL P 20 P 3 P 4 NULL P 5 P 22 NULL P 6 P 23 P 24 NULL P 7
TS00 TS00

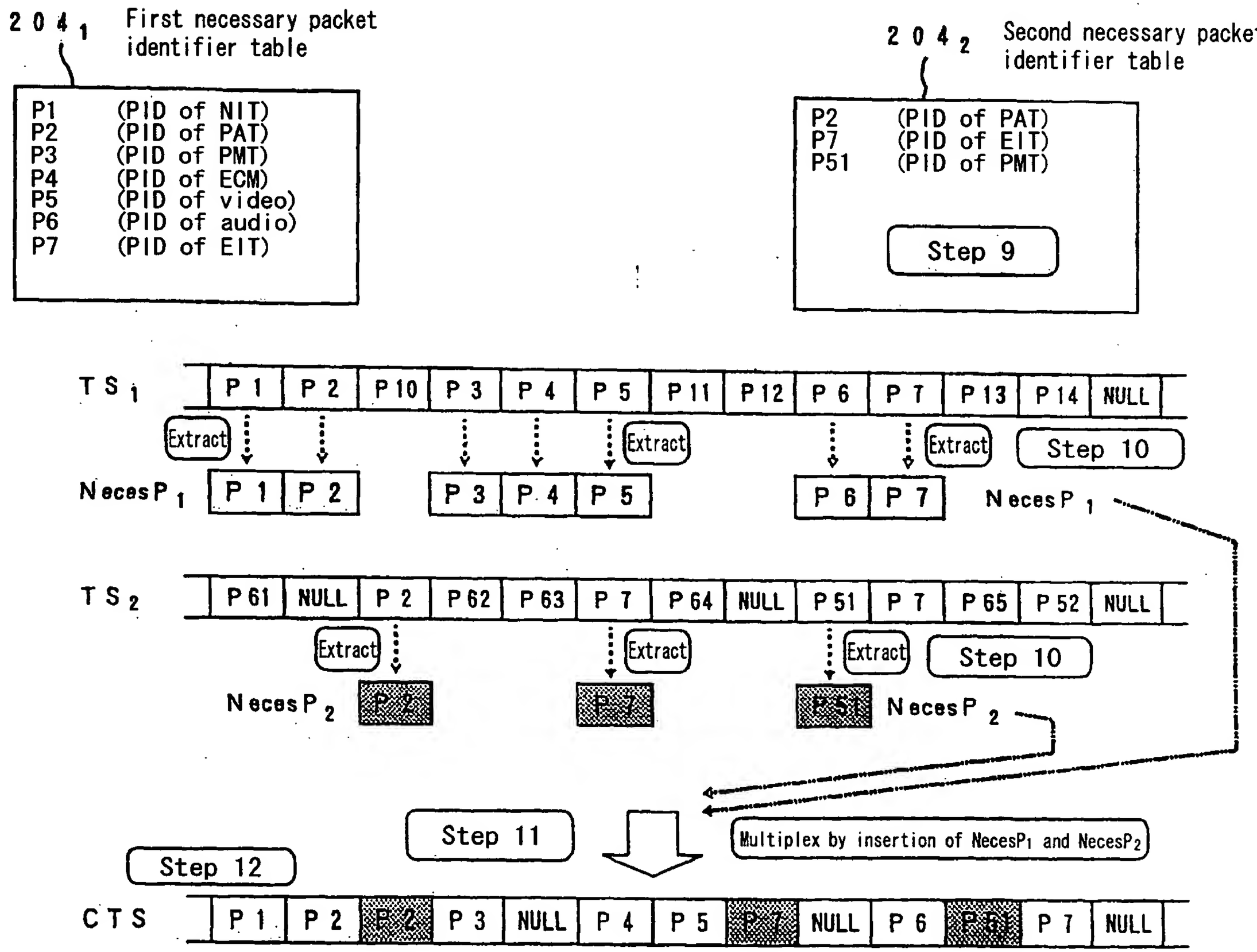
【FIG. 20】


Multiplexer section
103
104
TS separating section
CTS
TS packet inserting section
501
NecesP
First TS packet extracting section
2031
First necessary PID table
2041
Second TS packet extracting section
2032
Second necessary PID table
2042
n-th TS packet extracting section
203n
n-th necessary PID table
204n
TS1
TS2
TSn
First demodulator section
1022
Second demodulator section
102n
n-th demodulator section
First tuner
1011
Second tuner
1012
n-th tuner
101n
Modulated wave

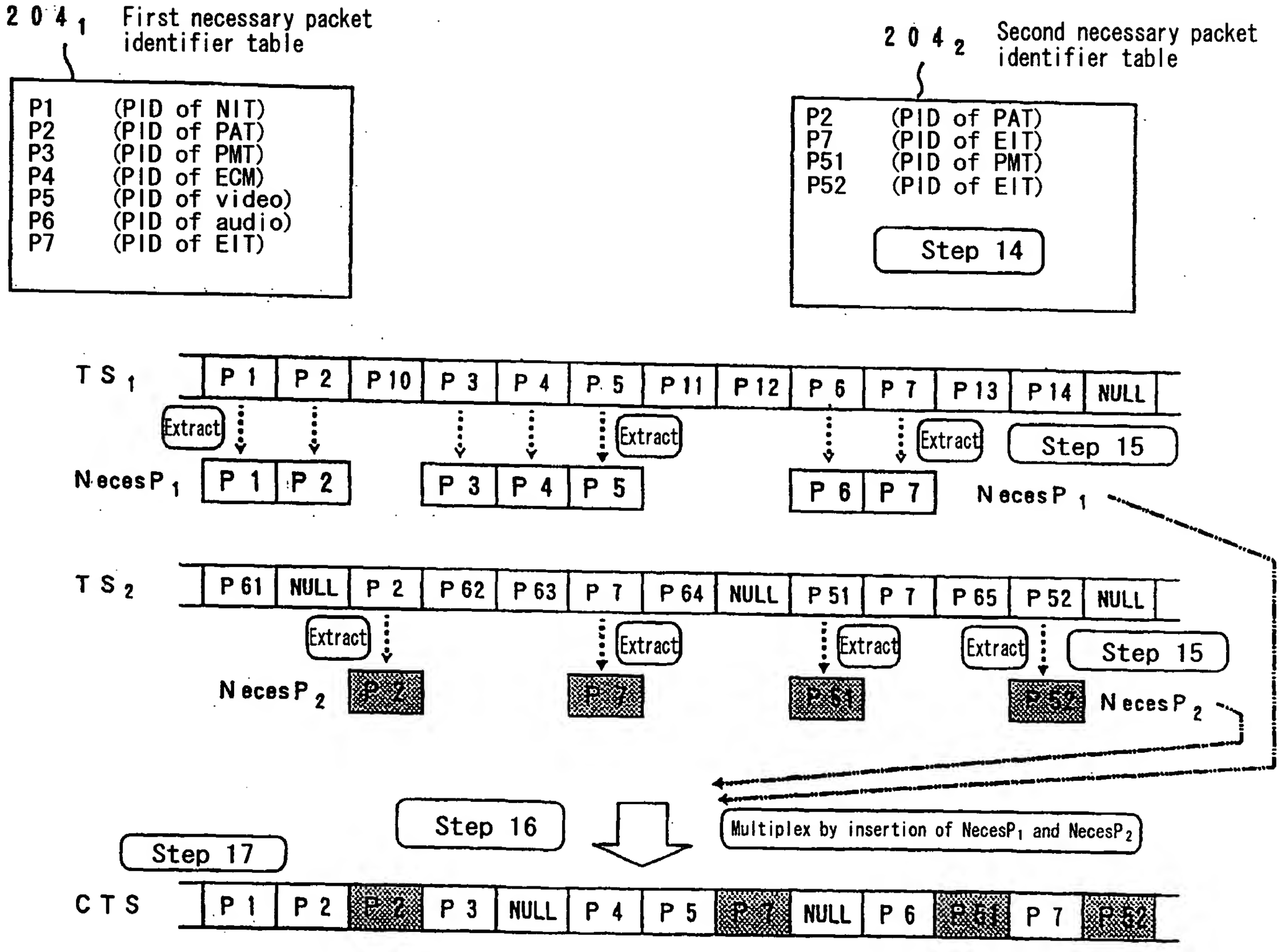
【FIG. 21】


2042 Second necessary packet identifier table
(PID of PAT)
(PID of EIT)
P2
P7
Step 4
Extract
Step 5
NecesP1
Multiplex by insertion of NecesP1 and NecesP2
Step 6
NecesP2
2041 First necessary packet identifier table
(PID of NIT)
(PID of PAT)
(PID of PMT)
(PID of ECM)
(PID of video)
(PID of audio)
(PID of EIT)
P1
P2
P3
P4
P5
P6
P7
Step 1
TS1
NecesP1
TS2
NecesP2
Step 7
CTS

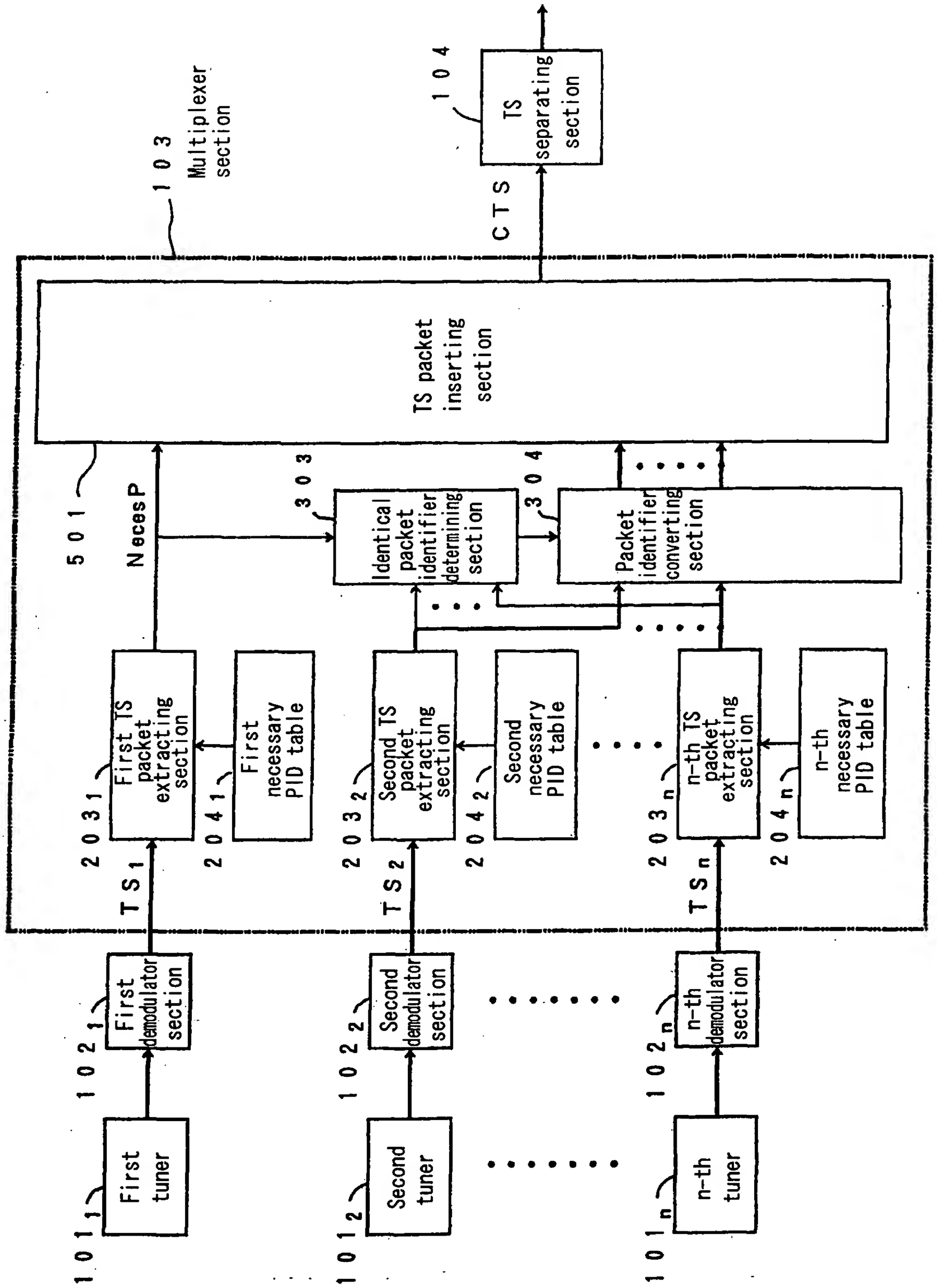
【FIG. 22】


204 1
First necessary packet identifier table
P1 (PID of NIT)
P2 (PID of PAT)
P3 (PID of PMT)
P4 (PID of ECM)
P5 (PID of video)
P6 (PID of audio)
P7 (PID of EIT)
204 2
Second necessary packet identifier table
P2 (PID of PAT)
P7 (PID of EIT)
P51 (PID of PMT)
Step 9
TS 1
P 1 P 2 P 10 P 3 P 4 P 5 P 11 P 12 P 6 P 7 P 13 P 14 NULL
Extract
Step 10
NecesP 1
P 1 P 2 P 3 P 4 P 5 P 6 P 7
TS 2
P 61 NULL P 2 P 62 P 63 P 7 P 64 NULL P 51 P 7 P 65 P 52 NULL
NecesP 2
Step 11
Multiplex by insertion of NecesP1 and NecesP2
Step 12
CTS
P 1 P 2 P 2 P 3 NULL P 4 P 5 P 7 NULL P 6 P 51 P 7 NULL

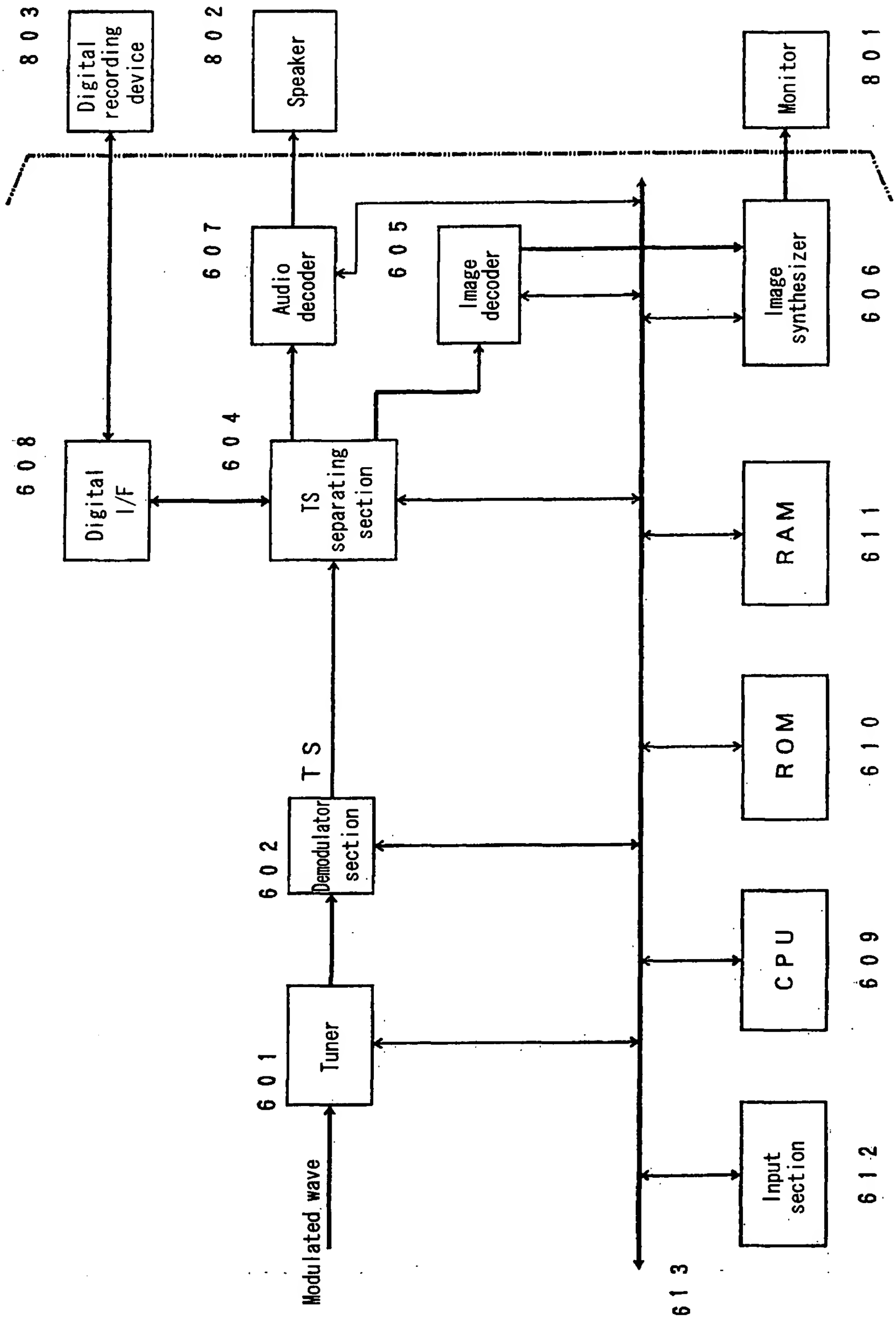
【FIG. 23】


204 1 First necessary packet identifier table
P1 (PID of NIT)
P2 (PID of PAT)
P3 (PID of PMT)
P4 (PID of ECM)
P5 (PID of video)
P6 (PID of audio)
P7 (PID of EIT)
204 2 Second necessary packet identifier table
P2 (PID of PAT)
P7 (PID of EIT)
P51 (PID of PMT)
P52 (PID of EIT)
Step 14
TS 1
P 1 P 2 P10 P 3 P 4 P 5 P11 P12 P 6 P 7 P13 P14 NULL
Extract
Extract
Extract
Step 15
NecesP 1
P 1 P 2
P 3 P 4 P 5
P 6 P 7
NecesP 1
TS 2
P 61 NULL P 2 P 62 P 63 P 7 P 64 NULL P 51 P 7 P 65 P 52 NULL
Extract
Extract
Extract
Extract
Step 15
NecesP 2
P 2
P 7
P 51
P 52
NecesP 2
Step 16
Multiplex by insertion of NecesP1 and NecesP2
Step 17
CTS
P 1 P 2 P 2 P 3 NULL P 4 P 5 P 7 NULL P 6 P 61 P 7 P 52

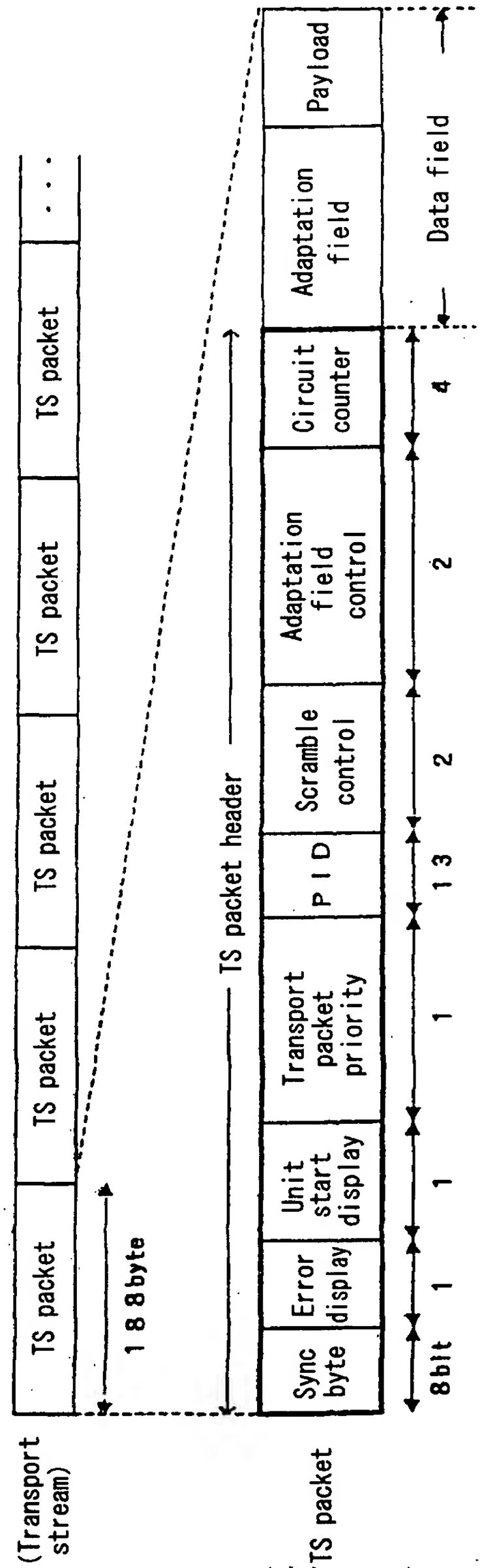
【FIG. 24】


103
Multiplexer section
104
TS separating section
CTS
TS packet inserting section
501
NecesP
303
Identical packet identifier determining section
304
Packet identifier converting section
2031
First TS packet extracting section
2041
First necessary PID table
2032
Second TS packet extracting section
2042
Second necessary PID table
203n
n-th TS packet extracting section
204n
n-th necessary PID table
TS1
TS2
TSn
1021
First demodulator section
1022
Second demodulator section
102n
n-th demodulator section
1011
First tuner
1012
Second tuner
101n
n-th tuner

【FIG. 25】


803
Digital recording device
802
Speaker
801
Monitor
607
Audio decoder
605
Image decoder
606
Image synthesizer
608
Digital I/F
604
TS separating section
602
Demodulator section
TS
601
Tuner
Modulated wave
RAM
611
ROM
610
CPU
609
Input section
612
613

【FIG. 26】


(Transport stream)
TS packet
TS packet
TS packet
TS packet
TS packet
. . .
188byte
TS packet
Sync byte
Error display
Unit start display
Transport packet priority
PID
Scramble control
Adaptation field control
Circuit counter
Adaptation field
Payload
Data field
8bit
1
1
13
2
2
4